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KARN/WEADOCK GENERATING COMPLEX EXPANSION PROJECT (BAY COUNTY) - MDNRE FILE NUMBER 09-09-0006-P

Dear Ms. Fish:

I am writing to you on behalf of Consumers Energy Company (Consumers) in follow-up to the February 26, 2010 meeting between the Michigan Department of Natural Resources and Environment (MDNRE) and Consumers' representatives concerning the wetlands permit for the expansion of the Karn/Weadock Generating Complex in Hampton Township, Michigan. Consumers appreciates the time that you and your colleagues spent discussing Consumers' pending permit application.

This meeting was very helpful in clarifying that the single remaining issue concerning Consumers' joint permit application is whether the farm fields that would be impacted by project construction are effectively drained within the meaning of Part 303 of the Michigan Natural Resources and Environmental Protection Act, MCL 324.30305(3).[1] As Consumers has explained, these farm fields are not regulated under Part 303 because, in the absence of both wetland hydrology and hydrophytic vegetation, they are not wetlands. Regardless of

[1] For your ease of reference, a table of contents has been attached to the end of this letter. Additionally, citations in this letter to Part 303 are to the act as amended by 2009 PA 120. Citations to the Army Corps Manual refer to Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. Citations to the Regional Supplement refer to U.S. Army Corps of Engineers. 2009. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region,* ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-09-19. Vicksburg, Miss. U.S. Army Engineer Research and Development Center.

whether these fields may have been wetlands many decades ago, they were lawfully drained for agriculture. Consumers has presented the MDNRE with a substantial body of information that supports the conclusion that the fields are not wetlands and they have been effectively drained even under the new technical standards set by the United States Army Corps of Engineers (Army Corps) that MDNRE must now apply under Part 303 (see MCL 324.30301(2). The Army Corps' recent jurisdictional determination further supports the conclusion that these farm fields are effectively drained and are not subject to wetland regulation.

The MDNRE has asked Consumers to prepare a hydrological model to identify the effects of pumping on the farm fields as a way to resolve the effective drainage issue. The purpose of the model is to determine whether, in the absence of pumping, the fields would exhibit wetland hydrology under the Army Corps' technical standards. The MDNRE would agree that the fields are effectively drained if the pumping is not responsible for eliminating wetland hydrology in the fields. As this letter explains, Part 303 does not require the farm fields to be evaluated in an unpumped state and that sort of evaluation has been rejected under the Army Corps' technical standards that the MDNRE must now use. In any event, modeling the farm fields in an unpumped state does not alter or overcome the compelling evidence of effective drainage Consumers has already submitted to the agency and on which the Army Corps has relied in its jurisdictional determination.

Nevertheless, Consumers has prepared the hydrological model, which demonstrates that, in the absence of pumping, the farm fields would not exhibit wetland hydrology. Using water pumping data derived from electricity records and flow rates from the pumps located at these fields, the model shows that if the water removed by pumping during the wettest months of the year were "reapplied" to the fields, water levels would not reach the top twelve inches of the soil profile and, therefore, would not be saturated or inundated for fourteen or more consecutive days during the growing season. The fields would not have wetland hydrology in an unpumped state because they are influenced by a wide array of physical features (ditches, drains, levees, field tile, surface water runoff diversion) and natural factors (permeable soils, groundwater recharge, evaporation, evapotranspiration) that prevent water levels from constituting wetland hydrology. As this letter and the attached report concerning the hydrological model explain in more detail, there are very conservative assumptions underlying the model and, as a result, its conclusions regarding the effects of pumping fully resolve this issue.

As discussed at the February 2010 meeting, Consumers is submitting this letter and additional information to MDNRE so that the agency can review the materials in advance of the next meeting with Consumers. Consumers respectfully requests that the next meeting be held by the first week of April 2010 so that there is no further delay in processing its permit.

I. PART 303 DOES NOT REQUIRE THE FARM FIELDS TO BE EVALUATED IN AN UNPUMPED STATE

A. The Farm Fields Are Not Wetlands And, Therefore, Are Not Regulated Under Part 303

Part 303 regulates only certain activities that occur "in a wetland." See MCL 324.30304. A wetland is "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh, and which" also has one of the enumerated jurisdictional factors. See MCL 324.30301(1)(w). This definition requires hydrophytic vegetation, wetland hydrology, *and* hydric soils. See *People v Kozak*, unpublished per curiam opinion of the Michigan Court of Appeals, issued June 19, 2008 (Docket No. 272945), available at 2008 WL 2468469 (discussing definition of wetlands in Part 303).

The wetland delineation Consumers prepared and submitted to MDNRE confirms that the farm fields do not support wetland vegetation or aquatic life under normal circumstances. Nor do the fields exhibit the hydrology that would support wetland vegetation or aquatic life. Their continuing use for cultivation of commodity crops like corn, which does not tolerate wetland conditions, is also directly inconsistent with a conclusion that the farm fields are wetlands as defined in MCL 324.30301(1)(w). Thus, Part 303 has no role in regulating these fields because they are not, in fact, wetlands.

B. Pumping Is Part Of The Normal Circumstances Of The Farm Fields

These farm fields do not have wetland hydrology that supports wetland vegetation or aquatic life under normal circumstances because they were drained of any wetland hydrology and all prior vegetation was removed and replaced with upland crops as part of the fields' conversion to agriculture many decades ago. MDNRE's request that Consumers evaluate the farm fields in an unpumped state suggests that pumping cannot be considered part of the "normal circumstances" of the farm fields and the effects of pumping must be excluded to determine whether wetland hydrology would exist in the farm fields in the absence of pumping.[2] That analysis wrongly assumes that wetland hydrology alone would define an area as wetland when MCL 324.30301(1)(w) unambiguously requires the existence of wetland hydrology sufficient to support wetland vegetation or aquatic life in actuality. The absence of wetland vegetation or aquatic life in the fields is dispositive of whether these fields are regulated wetlands: they are not wetlands and the hypothetical presumption that wetland hydrology might exist simply is not enough to meet the statutory definition of a wetland.

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[2] MDNRE's interpretation of normal circumstances would have harsh implications for farmers of effectively drained agricultural land in Michigan under the Swampbuster provisions of the Food Security Act, 16 USC 3801 *et seq*. See, e.g., 16 USC 3821 (agricultural production on wetlands is ineligible for federal farm subsidies and loans).

Part 303 does not define what constitutes "normal circumstances." However, the language of MCL 324.30301(1)(w) suggests that normal circumstances are those facts typically or ordinarily found at the time a jurisdictional decision must be made, which is why Michigan courts consider evidence of wetland indicators close in time to a project under consideration. See *Citizens Disposal, Inc v Dept of Natural Resources*, 172 Mich App 541, 551; 432 NW2d 315 (1988) (considering evidence of wetlands "artificially" and "recently" created due to nearby highway construction). Information from the United States Department of Agriculture indicates that occasional pumping of the drainage ditches has been used as part of agricultural production in these fields for many decades. See **Exhibit A, USDA Documents.** Occasional pumping is certainly part of the typical, ordinary, and even expected farming practices for these fields. Nothing in Part 303 or the Part 303 rules purports to exclude pumping from the normal circumstances at a project site and, therefore, it cannot and should not be excluded from the normal circumstances that are used to evaluate whether wetlands exist in these fields.

Case law also suggests that the pumping at these farm fields is properly considered part of the normal circumstances because it is part of the ***lawful*** alteration of any wetlands that historically existed there. In *City of Romulus v Michigan Dept of Environmental Quality*, 260 Mich App 54; 678 NW2d 444 (2003), the plaintiff municipalities argued that MDEQ could not issue a license to construct an injection well for the disposal of hazardous waste because the injection well facility would be constructed on a wetland, which was prohibited by state hazardous waste laws. See *id.* at 56. However, MDEQ had issued a Part 303 permit to the injection well licensee to fill 3.5 acres of wetland as part of its facility construction. See *id.* at 58-59. The injection well licensee then "filled and eliminated" the wetlands at the project site pursuant to the Part 303 permit. *Id.* at 62. Both the circuit court and the Court of Appeals concluded that the injection well license was properly issued because "[o]nce wetlands are filled, they no longer exist" and the hazardous waste law did not prohibit "construction on land formerly designated as a wetland." *Id.* at 68. The Court of Appeals went on to interpret the normal circumstances of the injection well site by explaining that "[o]nce a wetland is filled or eliminated in compliance with a Part 303 permit, it loses the characteristics of a wetland and is no longer a wetland." *Id.* at 68, n 11. In other words, the Court of Appeals concluded the normal circumstances of the injection well site included all conditions allowed by law, even if those conditions included the elimination of a wetland.

Any wetlands in these farm fields were eliminated in a manner just as lawful as the filling that occurred pursuant to permit in the *Romulus* case. Historical aerial photographs reveal that these were farm fields – not wetlands – well before Michigan enacted its first laws regulating wetlands starting in 1980. See Geomare-Anderson Wetlands Protection Act, 1979 PA 203 (adopting first regulation of wetlands in state effective in 1980). Similarly, the 1919 map the Army Corps attached to its December 22, 2009 memorandum supporting its jurisdictional determination indicate that these fields were not wetlands many decades before passage of Michigan's wetlands laws. To the extent that pumping occurred and contributed to the elimination of wetland hydrology and the elimination of wetland vegetation prior to 1980, that pumping was lawful because there was no state law prohibiting drainage of wetlands in that pre-

1980 timeframe. Farmers were literally free to eliminate wetlands in their fields by any means available to them.

When Michigan adopted its first wetland law, it provided a farming drainage exemption that excluded from regulation previously drained agricultural land and allowed for its continuing drainage outside the regulatory scheme. That exemption now appears in MCL 324.30305(3), which states that "[a]n activity in a wetland that was effectively drained for farming before October 1, 1980 and that on and after October 1, 1980 has continued to be effectively drained as part of an ongoing farming operation *is not subject to regulation under this part*." Emphasis added. In other words, farm fields that qualify for the effective drainage exemption were not regulated under any state law prior to 1980 and they remain unregulated under state wetlands law in effect after 1980.

This continuous lack of state regulation of the farm fields is a critical factor that MDNRE has not taken into consideration in its analysis of the normal circumstances for these fields. See, generally, *Huggett v Dept of Natural Resources*, 464 Mich 711, 723-724; 629 NW2d 915 (2001) (considering drainage of property for agriculture in comparison to the October 1, 1980 threshold date to determine whether effective drainage exemption applied). As the Michigan Court of Appeals explained in *Citizens Disposal*, *supra* at 551, the purpose of state wetland laws is "to ensure the preservation and protection of the wildlife habitats known as wetlands." State wetland laws have no reason to protect lands by limiting methods to accomplish drainage where there are no wetlands to be protected, such as at these farm fields. Nor would MDNRE have authority based in Part 303 to place limitations on the methods by which drainage may be accomplished at these fields when the Legislature has made those lands exempt from all regulation under Part 303.

The distinction that MDNRE attempts to draw between pumping, which it would exclude from normal circumstances, and other methods of drainage, which it would consider part of normal circumstance, is artificial at best and has no statutory basis. There is no practical difference between the effects of pumping and the use of ditches, field tiles, and other water control structures that rely solely on gravity for their operation. Pumping and other drainage methods all seek to remove water from farm fields and have the effect of eliminating wetland indicators.

If there were an important legal distinction between any of these drainage methods, the Michigan Legislature surely would have identified it in Part 303 and its predecessor laws. By 1980, pumping was well-established as a method to manipulate water levels in drainage ditches in order to improve gravity drainage by field tile systems as part of an overall drainage strategy. The Legislature could have easily prohibited the use of pumps for drainage. However, the Legislature did not address any specific methods of drainage for farm fields that are exempt from regulation under Part 303, whether in the context of defining which lands qualify for the exemption or for any other purpose. For instance, Part 303 does not say that the effective drainage exemption in MCL 324.30305(3) applies only to fields that were drained by gravity prior to 1980. Nor does Part 303 prohibit the use of pumps to ensure that fields have "continued to be effectively drained as part of an ongoing farming operation" after October 1, 1980. In fact, Part 303 does not refer to gravity drainage at all and uses the word "pump" just once, in reference to a "pump house." See MCL 324.30305b(2)(a) (construction of "pump houses" for cranberry cultivation is not water-dependent activity). This reference to pump houses suggests that even regulated wetlands may be lawfully pumped under normal circumstances, which would be even more obviously true for wetlands that are not regulated under Part 303.

Additionally, it is notable that MDNRE has not attempted to promulgate any rules that would clarify when the effective drainage exemption in MCL 324.30305(3) applies, much less that attempt to limit the use of pumping at unregulated lands. See Rule 281.921 *et seq.* (wetland rules). Nor has MDNRE promulgated an administrative rule that excludes pumping from the normal circumstances under which the evidence of wetland criteria, and specifically wetland hydrology, must be identified. See Rule 281.924(3). The conclusion to be drawn from the absence of administrative rules addressing this pumping issue is that MDNRE may be interested in understanding the nature and extent of pumping at these farm fields, but the agency has not attempted to make pumping determinative of whether a farm field is effectively drained under Part 303.[3]

In sum, there is no basis in Part 303 to exclude pumping from the normal circumstances used to determine whether wetland criteria exist, especially for unregulated lands like these farm fields. To the contrary, Part 303 makes no effort to identify any particular methods of drainage that must be treated differently than others. Nor has MDNRE taken any steps to promulgate rules that would attempt to exclude pumping from normal circumstances at agricultural lands – and it would not have the authority to take such a step. Consequently, MDNRE has no legal basis to exclude pumping when evaluating the normal circumstances for wetland indicators or to treat it as a decisive factor in jurisdictional decisions under Part 303.

C. The Farm Fields Are Effectively Drained For Agriculture

There can be no doubt that the fields are actually "effectively drained" within the meaning of MCL 324.30305(3). While Part 303 does not provide a definition of effective drainage, its meaning is plain. To paraphrase Merriam-Webster, to deal with something effectively means to achieve a "decided, decisive, or desired effect" or result. See Merriam-Webster Online Dictionary (visited March 23, 2010) <http://www.merriam-webster.com/ dictionary/effectively> and <http://www.merriam-webster.com/dictionary/effective>. In this case, the desired result is drainage, or the removal/absence of hydrology that would be inconsistent with growing nonwetland crops.

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[3] To be clear, MDNRE's wetland rules do not apply here because these fields are not regulated by Part 303. MDNRE would also lack the statutory authority to promulgate a rule attempting to limit the applicability of MCL 324.30305(3) because the Legislature has not delegated the responsibility for defining or limiting that exemption to MDNRE. See *In re Quality of Service Standards for Regulated Telecommunication Services*, 204 Mich App 607, 611; 516 NW2d 142 (1994) ("Administrative authority must be granted affirmatively or plainly, because doubtful power does not exist.") (internal citations omitted).

Consumers has demonstrated that wetland hydrology does not exist for these farm fields because they are influenced by drainage ditches, levees, surface water runoff diversion, and a field tile system. The fields are also influenced by regional drainage, such as the county drains and the operation of county pump stations, which are outside Consumers' control. The absence of wetland hydrology has been verified in multiple visits to the farm fields, which do not support wetland vegetation or aquatic life, are cropped with nonwetland plants, and show highly effective water removal after precipitation events. While Consumers is submitting a hydrological model substantiating its claim that, in the absence of pumping, these fields will not exhibit wetland hydrology, it would be lawful for pumping to augment the effective drainage caused by these physical features. The historical aerial photographs also make clear that the drainage occurred for agriculture before October 1, 1980 and that it continued for farming after that date. As a result of all these factors and the other evidence Consumers has submitted, these fields fit within the exemption in MCL 324.30305(3) and any construction that would occur in them is not regulated by Part 303 because the fields are not subject to Part 303.

II. THE ARMY CORPS' TECHNICAL STANDARDS AND THE EPA LETTER DO NOT REQUIRE THE FARM FIELDS TO BE EVALUATED IN AN UNPUMPED STATE AND SUPPORT THE CONCLUSION THAT THESE FIELDS ARE NOT WETLANDS

Consumers has also attempted to understand the basis on which MDNRE claims that the farm fields must be evaluated as if they are not subject to pumping given the requirement that MDNRE use the Army Corps' technical standards for identifying wetlands. See MCL 324.30301(2). MDNRE has not claimed to be following state guidance, which has been prohibited by MCL 324.30311a(1). Nor is it apparently following any state administrative rules to require the fields to be evaluated in an unpumped state. Rather, MDNRE has indicated that it is following the technical standards set by the Army Corps in its Wetland Delineation Manual (1987) (Manual) and in the Interim Northcentral and Northeastern Regional Supplement (2009) (Regional Supplement) to identify wetlands under Part 303. MDNRE also pointed to Army Corps Regulatory Guidance Letter (RGL) 90-07 and an unpublished 1997 letter from EPA as the basis for the conclusion that the farm fields must be evaluated for wetland hydrology as if they were not pumped.

MDNRE's claim that it is following the Army Corps' technical standards when seeking to evaluate the fields in the absence of pumping is perplexing given that the Army Corps has applied its own guidance to the fields in their cropped (pumped) state and concluded that the fields are not wetlands. Likewise, it is difficult to understand on what basis MDNRE could rely on RGL 90-07 when that guidance includes hydrological alterations like pumping in the normal circumstances of agricultural fields and confirms that wetlands converted to agriculture cease to have values that are protected by regulation.

As the following sections explain in more detail, the Army Corps' technical standards, as well as its jurisdictional determination for these fields, provide substantial, additional support for the conclusion that the farm fields are not regulated wetlands. Though the Army Corps is concerned with wetlands under Section 404 of the Clean Water Act, Part 303 has been amended to incorporate the technical standards that the Army Corps uses and to identify circumstances when MDNRE is obligated to follow the Army Corps' lead in permitting decisions. See MCL 324.30301(2); MCL 324.30304b. The Army Corps' technical standards are also particularly germane because – like Part 303 – Section 404 exempts prior converted cropland from regulation, i.e., wetlands that have been drained for agriculture. See 33 CFR 328.3(a)(8); 58 Fed Reg 45008, 45031 (August 25, 1993). Because these farm fields are prior converted cropland (PC cropland) and do not constitute wetlands under the Army Corps' technical standards, MDNRE should also find that the farm fields are not wetlands and are effectively drained. The 1997 letter from the EPA that MDNRE has cited is not applicable to or binding on Consumers, nor does it change this conclusion that the farm fields are unregulated.

A. The Reasoning Behind The Prior Converted Cropland Exemption Supports The Determination That These Farm Fields Are Exempt From Regulation Under State Law

Section 404 of the Clean Water Act regulates wetlands that are part of the "waters of the United States." See 33 USC 1344 (requiring permit for dredge or fill in navigable waters); 33 USC 1362(7) (defining navigable waters to include waters of the United States and territorial seas). However, under the federal regulations adopted by EPA and the Army Corps in 1993, prior converted cropland (PC cropland) do not constitute "waters of the United States." See 33 CFR 328.3(a)(8); 58 Fed Reg 45008, 45031 (August 25, 1993). Prior converted cropland are

> areas that prior to December 23, 1985, were drained or otherwise manipulated for the purpose, or having the effect, of making production of a commodity crop possible. PC cropland is inundated for no more than 14 consecutive days during the growing season and excludes pothold [sic] or playa wetlands. [58 Fed Reg 45008, 45031 (August 25, 1993).]

Excluding PC cropland from wetland regulation was "consistent with the agencies' paramount objective in protecting the nation's aquatic resources." *Id.* at 45032. EPA and the Army Corps recognized that PC cropland property

> has been significantly modified so that it no longer exhibits its natural hydrology or vegetation. Due to this manipulation, PC cropland no longer performs the functions or has values that the area did in its natural condition. PC cropland has therefore been significantly degraded through human activity and, for this reason such areas are not treated as wetlands under the Food Security Act. Similarly, in light of the degraded nature of these areas, we do not believe that they should be treated as wetlands for the purposes of the CWA. [58 Fed Reg 45008, 45032 (August 25, 1993).]

As documented in prior submissions by Consumers, the Natural Resources Conservation Service (NRCS) has determined that these farm fields are PC cropland. If MDNRE were truly following the reasoning advanced by EPA and the Army Corps, it would likewise conclude that these fields ceased to be wetlands long ago and are not subject to regulation today. This reasoning behind the federal exemption for PC cropland is very similar to the way the Michigan Court of Appeals has viewed the purpose of state wetland laws in *Citizens Disposal*, *supra*, and the effect of lawful elimination of wetlands in *Romulus*, *supra*. Thus, MDNRE should agree with EPA and the Army Corps that these fields are not regulated because they are not wetlands.

B. Normal Circumstances Do Not Include Looking For Wetland Indicators That May Have Historically Existed At The Farm Fields

The decision by EPA and the Army Corps to promulgate this regulatory exemption for PC cropland also sets the stage for understanding why the Manual does not require that lawfully drained farmland be evaluated in an unpumped state to determine whether wetland indicators could exist if the land were used and managed differently.

Under the Clean Water Act, "wetlands" are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under *normal circumstances* do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." 33 CFR 328.3(b) (emphasis added). The term "normal circumstances" has not been defined in the Clean Water Act or its regulations; however, the Army Corps has concluded that the term "normal circumstances" is intended to limit the agencies from asserting jurisdiction over areas based on historic conditions. As the Army Corps explained when adopting the regulatory definition of wetlands, "We have responded to the concern for the vagueness of the term 'normally' by replacing it with the phrase 'and that under normal circumstances do support . . . .' We do not intend, by this clarification, to assert jurisdiction over those areas that once were wetlands and part of an aquatic system, but which, in the past, have been transformed into dry land for various purposes." 42 Fed Reg 37122, 37128 (July 19, 1977). Further, the Army Corps interprets its authority under Section 404 of the Clean Water Act "to regulate discharges of dredged or fill material into the aquatic system as it exists, and not as it may have existed over a record period of time." *Id.*

Similarly, the Army Corps has addressed the issue of "normal circumstances" in multiple RGLs, including 82-02, 86-09, and 90-07. Most pertinent to these farm fields, the Army Corps stated in RGL 86-09 that

> [m]any areas of wetlands converted in the past to other uses would, if left unattended for a sufficient period of time, revert to wetlands solely through the devices of nature. However, such natural circumstances are not what is meant by 'normal circumstances' in the definition quoted above. 'Normal circumstances' are determined on the basis of an area's characteristics and use (other than by recent un-permitted action not subject to 404(f) or 404(r) exemptions) and if that use alters its wetland characteristics to such an extent that it is no longer a 'water of the United States,' that area will no longer come under the Corps regulatory jurisdiction for purposes of Section 404. However, if the area is abandoned and over time regains wetland

characteristics such that it meets the definition of 'wetlands,' then the Corps 404 jurisdiction has been restored. [RGL 86-09.]

The Army Corps provided a similar explanation for its view of PC cropland in RGL 90-07, where it said:

In contrast to "farmed wetlands", "prior converted croplands" generally have been subject to such *extensive and relatively permanent physical hydrological modifications and alteration of hydrophytic vegetation that the resultant cropland constitutes the "normal circumstances"* for purposes of section 404 jurisdiction. Consequently, the "normal circumstances" of prior converted croplands generally do not support a "prevalence of hydrophytic vegetation" and as such are not subject to regulation under section 404. In addition, our experience and professional judgment lead us to conclude that because of the magnitude of hydrological alterations that have most often occurred on prior converted cropland, such cropland meets, minimally if at all, the Manual's hydrology criteria. [RGL 90-07, paragraph 5.d (emphasis added).]

In other words, rather than requiring agricultural land to be evaluated as if it were not pumped or otherwise drained, the Army Corps accepts the site alterations that support farming as the normal circumstances used to evaluate the existence of wetland indicators on agricultural land.

The Manual adopts this concept of "normal circumstances" as the contemporary or existing conditions by requiring "evidence of a minimum of one positive wetlands indicator from each parameter (hydrology, soil, and vegetation) . . . in order to make a positive wetland determination." Manual, page 10. The "permanence" of structures or alterations is important in determining normal circumstances. *Id.* at 74; see *id.* at 80, note 1 (suggesting alterations to wetland hydrology that occur "prior to implementation of Section 404" are viewed differently from more recent alterations); see also 58 Fed Reg 45032 incorporating RGL 90-07 ("the primary consideration in determining . . . 'normal circumstances' involves an evaluation of the extent and relative permanence of the physical alteration of wetlands hydrology and hydrophytic vegetation").

By seeking to evaluate the farm fields in their unpumped state, MDNRE is not following the Army Corps' technical standards for evaluating normal circumstances, much less applying the approach to normal circumstances outlined in RGL 90-07. Rather than looking at the farm fields as they currently exist and are managed,[4] MDNRE is attempting to recreate hypothetical historical circumstances that may have existed in these fields before pumping and other drainage techniques were instituted. Those hypothetical historical circumstances are not relevant to understanding whether wetland hydrology exists today and whether, under normal circumstances, it does support wetland vegetation. See CFR 328.3. Part 303 closely tracks this definition of wetlands and incorporates the same concept of normal circumstances. See MCL

[4] EPA and the Army Corps view PC cropland as exempt from regulation without respect to the type of activity occurring on the property or whether the property is being used for agricultural purposes. See 58 Fed Reg 45034.

324.30301(1)(w). In applying the Army Corps' technical standards, MDNRE is not permitted to look at these fields in their historical unpumped state, but must view their normal circumstances as including all methods of drainage traditionally used, including occasional pumping. This is plainly the correct approach given the relative permanence, i.e., long-term use, of pumps as part of a larger drainage system, albeit a very small part of that system. Viewed under its current normal circumstances, Consumers' wetland delineation plainly establishes that these fields lack the requisite wetland indicators to be considered wetlands.

C. These Farm Fields Cannot Be Evaluated Under Section F Of The Army Corps' Manual Concerning Atypical Circumstances

MDNRE attempts to avoid the way the Manual defines normal circumstances by relying on the Manual's approach to atypical situations. See Manual, Section F. However, lawful drainage for farming does not constitute an atypical circumstance subject to analysis under Section F of the Manual.

Section F applies only where the three wetland criteria cannot be found "due to the effects of *recent human activities* or natural events." Manual, page 73 (emphasis added). This section of the Manual does not apply to lawfully drained farm land because it only applies in three situations: (1) unauthorized activities; (2) natural events such as fire, etc., (3) and man-induced wetlands. Section F specifically provides that it "*should not be used* for activities that have been previously authorized *or those that are exempted from CE* [Army Corps of Engineers] *regulation.* For example, *this section is not applicable to areas* that have been drained under CE authorization or *that did not require CE authorization.*" *Id.* at 74 (emphasis added). Section F of the Corps Manual also states that, when using the methods for evaluating atypical situations, the individual conducting the study must "determine the approximate date when the alteration occurred." *Id.* at 75. A footnote to that instruction emphasizes that it is "*especially* important to determine whether the alteration occurred prior to implementation of Section 404." *Id.* (emphasis added).

In this instance, the PC cropland determination, USDA records, and the aerial photographs dating back to the early twentieth century establish that these fields did not require authorization to be drained because they were drained before laws regulating wetlands were passed by Congress and the Michigan Legislature. This long history is evidence of the relative permanence of the alterations accomplished at the farm fields. There is no evidence that recent human activities resulted in drainage that would allow the farm fields to be evaluated under the atypical circumstances procedures. In fact, the conversion of these fields is the result of essentially ancient, not recent, human activities. Finally, these fields do not fit within any of the categories established in Section F because their condition has not resulted from unauthorized activities or natural events, and are not man-induced wetlands. Consequently, under the standards used by the Army Corps, MDNRE must simply evaluate the fields for the presence of the three wetland indicators under their current-day, i.e., normal, circumstances. In the absence of both wetland hydrology and wetland vegetation, these fields are not wetlands under federal or state law.

D. Even If There Were Atypical Circumstances, These Farm Fields Would Not Be Deemed Wetlands Under Section F Of The Manual And Regional Supplement

Even if there were atypical circumstances to evaluate under Section F of the Manual and Regional Supplement, these farm fields would not be considered wetlands. The Regional Supplement addresses six different methods for identifying whether "wetland hydrology is present on a managed site under normal circumstances, as defined in the Corps Manual and subsequent guidance." Regional Supplement, page 120; see also page 117 (optional methods may be used only when a particular wetland indicator may be missing due to "recent disturbances" or "recent human activities"). The six methods for evaluating wetland hydrology under atypical circumstances are: (a) conduct a site visit to look for evidence of wetland hydrology; (b) examine five or more years of aerial photographs for evidence of wetness signatures or use the NRCS method to determine if wetlands exist; (c) estimate the drainage effects of "ditches and subsurface drainage systems using scope-and-effect equations"; (d) rely on state drainage guides "to estimate the effectiveness of an existing drainage system"; (e) use a hydrological model; or (f) monitor the hydrology of the site in relation to the appropriate hydrology technical standard. Regional Supplement, page 120; see also *id.* at 79-80. These methods are not cumulative; even where atypical circumstances exist, permit applicants do not need to use all six methods to establish the absence of wetland hydrology. Rather, these six methods are each "options." See *id.* at 118.

Although Consumers is not obligated to use the methods for atypical circumstances for these farm fields, Consumers already satisfied the first three methods that are listed in demonstrating the absence of wetland hydrology in the farm fields. MDNRE has made multiple site visits during a year with above-average precipitation without finding evidence of wetland vegetation or hydrology in the farm fields, confirming Consumers' wetland delineation. Consumers has presented aerial photographs dating to the early twentieth century that show non-wetland crops growing without wetness signatures. The historical timeline depicted in the photographs and maps far exceed the five-year benchmark in the Regional Supplement and are consistent with the prior converted cropland determination made by the NRCS. Documents obtained from the USDA note pumps in these fields in the 1950s, and pumping may have occurred even earlier. Consumers has also prepared scope and effect calculations that support the conclusion that the tile system is effective at draining the soil types found in the farm fields. Additionally, as MDNRE requested, Consumers prepared a hydrological model as described in method five that demonstrates that pumping at the site is to manage the crop cultivation and not to eliminate wetland hydrology. This gives further credence to the effectiveness of the larger system of ditches, county drains, levees, and surface water runoff diversion in draining these fields.

MDNRE has, nevertheless, suggested that each of the first three methods for assessing the existence of wetland hydrology have been affected by the existence of pumping at the site, making them inappropriate methods to use. However, the Regional Supplement does not require that any of the methods Consumers has used be performed in the absence of pumping or that it attempt to evaluate site conditions in an unpumped state, though pumping is used extensively in Michigan to move water in ditch and drain systems and over levees. As a technical document providing precise instructions for individuals conducting wetland delineations, the Regional Supplement would have expressly addressed pumping if these methods for identifying wetland hydrology could not be used at a site that is pumped. Minimally, the Regional Supplement would have explained what weight to give the existence of pumping or qualified the type or extent of pumping relevant to its wetland hydrology determination if it were such a defining issue. There would be no reason for a Regional Supplement issued so recently to be silent on the issue of pumping if it were such a critical and disqualifying factor for the methods that it provides for dealing with difficult circumstances. Thus, the exclusion of pumping as a key factor in the methods presented in the Regional Supplement is not a mere oversight, it signals the Army Corps' acceptance of pumping as part of normal – not atypical – circumstances at a site.

Of these six methods for evaluating wetland hydrology in difficult circumstances, the only method that requires evaluating the site in an unpumped condition is the hydrology monitoring option. However, the Regional Supplement does not list a preference for monitoring. If anything, listing monitoring as the sixth of six options suggests that it is used only rarely and is not favored given its expense and burdens, which include disrupting planting this season for the farmers who have leased the fields. Hydrology monitoring is a problematic approach because Consumers does not control the Drain Commissioner's pumps (though they have not been used for years) and there are unknown risks of flooding posed to property owners outside the project site who nevertheless rely on the ditch and drain system for drainage. These burdens are particularly unwarranted in light of the many other methods Consumers has used to confirm effective drainage, the fact that the farm fields need not be evaluated under the methods for atypical circumstances at all, and the delay that has already occurred with this permit application. In any event, MDNRE has concluded that whether to pursue groundwater monitoring or provide a hydrological model was up to Consumers, and Consumers has opted to provide the model.

For all these reasons, if there were any basis to evaluate the farm fields under the Army Corps' atypical circumstances procedures, the four out of six procedures Consumers has used all demonstrate that these fields do not have wetland hydrology or wetland vegetation. Therefore, these fields cannot be considered wetlands.

E. The Army Corps' Jurisdictional Determination Illustrates Why These Farm Fields Are Not Wetlands And Why They Do Not Need To Be Evaluated In An Unpumped State

The Army Corps' January 6, 2010, jurisdictional determination, which concluded that these farm fields are not wetlands, supports Consumers' interpretation and application of the Army Corps' technical standards to this site. As the Army Corps explained in its December 22, 2009 memorandum supporting the jurisdictional determination:

> The historical and current drainage of the area is the principal factor in determining Section 10 and Section 404 jurisdiction in the area. Information submitted by Consumers and independently found by us documented that the area had been ditched/drained and converted to agricultural land during the

late 1800s. This drainage and conversion to agriculture was completed well before the enactment of the Rivers and Harbors Act and obviously well before enactment of the Clean Water Act. Consumers provided a series of aerial photographs of the site to show the area has been continuously farmed since 1938. The Corps has a copy of a 1943 reprint of a 1919 USGS quadrangle map of the area that clearly differentiates most, if not all, of the project area as non-marsh/wetlands relative to the areas demarcated as marsh/wetlands north of a prominent beach ridge (Attachment 3). [Army Corps Memorandum, page 2.]

The Army Corps spent considerable time identifying the county drains and pumps, interior ditches and private pumps, and levees, explaining how they influenced drainage of the farm fields and prevented inundation. *Id.* at 2, 4-5. The Army Corps verified this information during its multiple site visits, from additional submittals it requested from Consumers, and with information it had in its own records. *Id.* at 2-5.

The Army Corps found the site to be dry at its site visits despite above-average precipitation from May through August. See Army Corps Memorandum, *supra* at 3-4, 5. The November 2009 site visit, when crops had been harvested and fields could be easily inspected, "clarified" the Army Corps' view of the "effectiveness of the field tile drains and the accompanying drainage ditches on the site." *Id.* at 6; see *id.* at 1-2. The Army Corps concluded that the private ditches and drains on the project site, working "in concert with field tiles, seemed very capable of sufficiently removing wetland hydrology from all of the farmed fields." *Id.* Scope and effect calculations by Consumers' consultant and the Army Corps supported the reported depth and spacing of tiles in the farm fields, which were likely optimized over more than a century of farming. See *id.* at 6-7.

The Army Corps concluded that historical evidence, site observations, plus the scope and effect calculations indicated that the "various combination of field tiles and ditches (i.e., gravity drainage) are capable of sufficiently removing wetland hydrology from all of the agricultural lands in the project area in most years." See Army Corps Memorandum, *supra* at 7. The Army Corps did not believe that "the operation of the 6 pumps located on or near the agricultural land in the project site appreciably enhances the ability of the gravity drainage system to eliminate wetland hydrology from the site." *Id.* Rather, "the primary purpose of the pumps is to allow farm equipment on the land as soon as possible in the early spring rather than to remove water that could otherwise be within 12 inches or less from the surface for 14 or more consecutive days during the growing season, at a minimum frequency of 5 years in 10. As noted by one of the farmers interviewed by Consumers, the pumps are used to quickly remove water from the fields that could otherwise be flooded during large rain events." *Id.* The Army Corps did not view those "irregular occurrences as evidence the existing gravity drainage systems do not have the capacity to sufficiently remove the wetland hydrology from the fields." *Id.*

The Army Corps was equally methodical in the way it searched for but did not find evidence of wetland vegetation in the farm fields at its multiple site visits. For instance, the Army Corps walked along "interior ditches," traversed the farm fields in an "east-to-west route," and looked at "field edges" and "between crop rows." See

Army Corps Memorandum, *supra* at 3-4. However, the Army Corps "found no areas in which volunteer hydrophytic/wetland vegetation was a noticeable presence on field edges or between crop rows." *Id.* at 4; see also Regional Supplement, page 114. When the Army Corps returned to the site in November 2009, "the leaves had dropped from all of the trees and shrubs on the site. These conditions enabled us to view sizeable portions of the project area and to walk to/in the fields and ditches and note their conditions." Army Corps Memorandum, *supra* at 5. Once again, the Army Corps did not find wetland vegetation.

The Army Corps analysis illustrates that the normal circumstances of this site *do include* the pumped conditions. While identifying the pumps at the site, the Army Corps did not ask for them to be shutoff or the site evaluated in an unpumped state. Nor did the Army Corps treat these farm fields as presenting atypical circumstances that require special evaluation. Rather, in applying its own standards, the Army Corps followed the Manual, Regional Supplement, and RGLs by looking for evidence of the three wetland indicators in the fields as they currently exist. If MDNRE is applying the Army Corps Manual and Regional Supplement, as it is required to do, it should take this same approach and reach the same result, concluding that the fields are not wetlands under their normal circumstances and that the more intensive procedures identified in Section F of the Manual and Regional Supplement do not apply. Further, while Consumers has modeled the effects of pumping, MDNRE should follow the Army Corps' lead and conclude based on the existing record that the relatively small size of the pumps, their poor maintenance, their infrequent use, and the large size of the fields that the pumps are not likely to contribute "appreciably" to site drainage.

F. The 1997 EPA Letter Is Not Applicable Or Binding

MDNRE is also relying on a June 26, 1997 letter from Ms. Sue Elston, the Regional Wetland Coordinator at EPA Region 5, to Ms. Peg Bostwick, the Section 404 Coordinator for the State of Michigan, to suggest that the site must be evaluated in an unpumped state. See **Exhibit B, EPA Letter (1997)**. According to the 1997 letter:

> It is EPA's long-standing policy that temporary and reversible pumping does not remove CWA jurisdiction from an area. If an area would meet wetland hydrology criteria but for the removal of water by pumping, then the area is subject to CWA jurisdiction, provided, of course, that the area also has hydric soils and would, under normal circumstances support hydrophytic vegetation. *In the implementation of this policy to exert CWA jurisdiction on a pumped area, the assertion that but for the pumping the area would demonstrate wetness sufficient to meet wetland hydrology criteria should be based on reliable records of the hydrologic condition of the area prior to pumping or a site-specific hydrologic analysis that demonstrates that, if pumping were to cease, the area would meet wetland hydrology criteria.* [Emphasis added.]

There are numerous reasons why this letter does not undermine the Army Corps' proper interpretation and application of its technical standards, nor require Consumers to evaluate the site in an unpumped state or to evaluate the effects of pumping in more detail.

First, the letter was written with respect to a particular project. While the letter purports to present a formal EPA policy, the letter is shaped by specific facts, most of which remain unknown and, therefore, cannot be generalized to the Consumers project. In particular, the letter does not appear to address land that has been farmed for decades and has been determined to be PC cropland, which are significant factors that likely distinguish this project from the project discussed in the letter.

Second, EPA's "long-standing policy" concerning "temporary and reversible pumping"[5] cited in the 1997 letter appears to relate to a site where annual pumping was the sole method for achieving effective drainage. Regardless of whether that is literally true for the project under consideration in 1997, it is certainly not true for these farm fields. Consumers' farm fields are effectively drained and protected from inundation by ditches, county drains, a field tile system, levees, and surface water runoff diversions. The pumps act as part of these water-control structures and are but a small part of water management used at the site for agriculture. Further, the letter clarifies that it does require an evaluation of the "normal circumstances," which includes pumping for these farm fields as explained previously.

Third, the 1997 letter apparently cites an unnamed EPA policy and does not attempt to set policy independently. There is no indication of the subject matter of this policy, whether it was formally adopted, or its relations to the Army Corps Manual and Regional Supplement. In any event, this letter does not establish the framework for MDNRE to apply any provisions within Part 303. Under current Michigan law, the Army Corps' Manual and the Regional Supplement are used to identify wetlands. In this instance, finding lawful drainage and the absence of wetlands is consistent with the Manual for the reasons the Army Corps has explained. That determination supports a state law finding of effective drainage.

Fourth, Part 303 is also very clear on which federal guidance documents are to be used to identify wetland boundaries. See MCL 324.30301(2). This 1997 EPA letter is not among the guidance documents incorporated by reference in Part 303. Moreover, even outside the wetlands context, intergovernmental and inter-agency memoranda and communications like the 1997 letter are not given the force or effect of law in Michigan. See MCL 24.207(g); see also MCL 207(h) (interpretive statements are not binding); 2008 OAG 7223, available at 2008 WL 5412880 (Attorney General concluded that operational memoranda devised by MDEQ are not legally binding and do not serve as an independent source of authority for agency). Thus, to the extent the 1997 letter relied on EPA policy stated elsewhere, it was not and is not now an authoritative interpretation of the circumstances under which farm fields can be considered effectively drained under Part 303 and cannot be applied to the Consumers project.

[5] If this is a reference to the "extensive and permanent" standard under the Manual, the farm fields meet that standard.

Additionally, the 1997 letter does not actually require that a pumped site be evaluated in an unpumped condition, as MDNRE originally suggested. Rather, the letter appears to permit the use of historical records or hydrological modeling to demonstrate that the site does not have wetland hydrology. Consumers has provided MDNRE with both types of data demonstrating the absence of wetland hydrology. As a result, even if this letter were relevant at all, Consumers would have complied with its requirements. Consequently, this letter can neither be used to require Consumers to conduct further investigation of field conditions without pumping, nor used to discredit the wetland delineation Consumers has already prepared identifying these fields as effectively drained/prior converted cropland consistent with the Army Corps Manual, the Regional Supplement, RGL 90-07, and Part 303.

III. THE HYDROLOGICAL MODEL DEMONSTRATES THAT THE DRAINAGE SYSTEM IS EFFECTIVE AT DRAINING THE FARM FIELDS AND THAT, ABSENT PUMPING, THE FIELDS WOULD NOT EXHIBIT WETLAND HYDROLOGY

Consumers has gathered additional information regarding the depth of an aquitard or other restrictive layer and pumping at the farm fields, which is related below. When that information is added to all the data in the record and the hydrological model Consumers has prepared, it is clear that the Army Corps correctly concluded that gravity drainage through physical structures like ditches, drains, and tile systems are primarily responsible for draining the fields for agriculture. Even though Consumers is not obligated to demonstrate the hydrology of the site in an unpumped condition under the Army Corps' technical standards, it nevertheless answers the question that MDNRE has been asking and resolves the issue in favor of immediately resuming permit processing for this project.

A. There Is No Shallow Aquitard Or Restrictive Layer

When MDNRE and Consumers met in February 2010, they were able to agree that the likely source of any wetland hydrology that could exist for these farm fields is from precipitation given the very deep groundwater table. Nevertheless, one MDNRE staff member suggested that the fields have a very shallow aquitard located roughly twelve inches below ground surface, which could cause soil saturation in the upper twelve inches of the soil column by causing perched water conditions. This conclusion was based on that MDNRE staff member's attempts to dig pits in the soil of the farm fields with hand tools and the depth to refusal. However, the pits were dug during the August 2009 site visit, when very dry conditions made the soil difficult to penetrate and the top of the loam or sandy loam layer was likely mistaken for an aquitard.

Consumers has gathered substantial additional information concerning the soils in these farm fields and also conducted an additional field investigation on March 16, 2010. The attached technical report details this information. However, in summary, there is no rock layer within *eighty* (80) inches of the ground surface. NRCS data show that the soil types present in these fields consist of at least 40% sand, which could not significantly retard the downward flow of water. Further, the NRCS has classified the soil types present in the farm fields as having high or moderately high hydraulic conductivity. Recent shallow soil borings in all of the fields in question also showed that the soil profile in the fields consists of loamy sand, loam underlain by sand, or loam to the full depth of the boring, i.e., to a depth of at least thirty inches.

The absence of a shallow aquitard or restrictive layer is consistent with the crops grown in the fields. For instance, corn is a deep-rooted crop with a root system that grows down to a depth of forty-eight inches or more below ground surface. Corn would not thrive in ten inches of soil, as suggested by MDNRE's shallow aquitard theory. Likewise, the deeper aquitard is consistent with the depth of the field tiles, which would not be nearly so effective at draining the farm fields if they were located *below* an aquitard and, therefore, positioned so they could not drain moisture from the layer of soil where crops grow. Further, local farmers have confirmed that they till their fields as deep as fourteen inches, which would have compromised the integrity of the shallow soil layer claimed to be an aquitard in numerous places if it truly existed at ten inches. The soils on the fields are a loam or loamy sand with a permeability of 2 inches to 0.2 inches per hour, meaning that precipitation that does not evaporate or is not used by the growing crops percolates down to the drainage system or the very deep groundwater table. Given these factors, the hypothesis that the fields are essentially a shallow bathtub that creates wetland hydrology by retaining all precipitation in the upper ten inches of the soil column is factually unsupportable.

B. The Use Of Portable Pumps Is Insignificant

At the February 2010 meeting, one MDNRE staff member indicated that she had spoken with Mrs. Felske, the wife of the farmer who farms the fields north of Arms Road and west of Jones Road, extending past Boutell Road. Mrs. Felske reportedly stated that portable pumps are used in the farm fields. Prior to the February 2010 meeting, Jim Walker, Consumers' Environmental Manager for this project, spoke with Mr. Felske. Mr. Felske stated that portable pumps were not used to drain the fields Mrs. Felske referenced. Mr. Walker confirmed this again with Mr. Felske following the February 2010 meeting.

Mr. Walker also spoke with Mr. Rausch, who farms the field east of Jones Road. Mr. Rausch said he did not use portable pumps to drain his fields. Both Mr. Felske and Mr. Rausch stated that they believed that the only farmer that had used a portable pump in the last few seasons was Mr. Tom Van Ochten, who farms the field in the northwest quadrant of Jones Road.

On March 22, 2010, Mr. Walker spoke with Mr. Van Ochten, who confirmed that he had used a portable pump for approximately 48 hours during the Spring of 2009. Mr. Van Ochten stated that he powered the portable pump with his tractor and that he had used the portable pump only because his normal pump was in disrepair. He stated that it was a very unusual circumstance that required the use of a portable pump. This one-time use of a portable pump on a substitute basis could have no more than a negligible effect on site conditions. Consumers has learned of no other evidence that portable pumps are used at these farm fields.

Consumers has prepared a very conservative model of the effects of pumping on the fields, which is addressed in the next section of this letter. Nevertheless, in the interest of greater accuracy in determining the volume of water pumped, Consumers has included the additional 48 hours of pump usage in its model to account for water pumped from this field. Even if portable pumps were used with more frequency at the farm fields, the model suggests additional use of portable pumps would not eliminate wetland hydrology given the very large size of the farm fields, the likely modest size of portable pumps, and the many other physical and natural features that contribute to drainage and water loss at these fields. In any event, without evidence that portable pumps are actually used to any significant degree or with the consistency required to eliminate wetland hydrology, there is no basis to disregard the objective evidence that these fields are not wetlands and are effectively drained in favor of conjecture.

C. The Hydrological Model Demonstrates Effective Drainage And Is Consistent With MDNRE Water Budget Guidance

Consumers used a water balance approach to estimate the level of water in the farm fields in its model, which is consistent with the methods MDNRE uses in other contexts to estimate the impact of certain activities on water levels. See **Exhibit C, *The Effect of Pumping on Water Levels in Several Farm Fields in Bay County, Michigan* (March 2010)**; see also MDNRE, Land and Water Management Division, Water Budget Guidance (March 3, 2010), available at <http://www.michigan.gov/deq/0,1607,7-135-3306_32341---,00.html>. Under the Manual, wetland hydrology "requires 14 or more consecutive days of flooding, ponding, and/or a water table 12 in. (30 cm) or less below the soil surface, during the growing season, at a minimum frequency of 5 years in 10 (50 percent or higher probability) . . . ." Regional Supplement, page 80. However, only inundation (not saturation or water table levels) for 15 or more consecutive days during the growing season is used to define when farmed lands have wetland hydrology. RGL 90-07, paragraph 5.a. As the Army Corps explains, PC cropland, which are not wetlands, are "*inundated* for no more than 14 consecutive days during the growing season." *Id.* (emphasis added). This technical standard for wetland hydrology in farm fields stated in RGL 90-07 is arguably a more flexible standard that Consumers is entitled to build into its model. However, to avoid debating the difference between and applicability of these two standards, the model looks at whether water levels would rise to within twelve inches of the surface if the fields were not pumped.[6]

By looking at physical features (drainage ditches and field tiles) and natural features (pore space in soils) that contribute to water storage, Consumers calculated the

[6] Consumers does not waive any argument that it may make concerning the appropriate standards or assumptions to apply in the model and reserves the right to revise the model using more realistic assumptions.

volume of water that can be stored in the farm fields. Using data regarding precipitation and gallons of water pumped in two prior years during the wet (non-growing) seasons, the model figuratively "reapplied" the water to the fields. By comparing the gallons of water pumped to the gallons of water storage available in a combination of tiles, drainage ditches, and the soil that is 12 inches to 40 inches below the ground surface, Consumers was able to determine that water levels would not have come within twelve inches of the surface of the fields if the fields had not been pumped. In other words, even when the volume of water pumped from the ditches is applied back to the fields in the model, there is unused storage capacity in the soil 12 inches to 40 inches below the ground surface. As a result, even if the fields were not pumped, the fields would not exhibit wetland hydrology because water levels would not rise to the top twelve inches of the soil profile.

Consumers used numerous conservative assumptions in order to eliminate as many questions as possible regarding the inputs to the model. For instance, the model excludes the effects of groundwater recharge, evaporation, and evapotranspiration, which would likely show that water levels would be much lower in the fields during the growing season if they were not pumped, while using precipitation data from a year categorized as "unusually moist" by the National Oceanic and Atmospheric Administration based on local precipitation data. The model calculates water storage in soil to a depth of only 40 inches, though a depth of 60 inches is scientifically supportable based on the soil types in the fields identified in soil surveys, field work confirming soil types, and a 1984 study regarding the permeability of those soils. The model allows for water storage in soil pore space that does not exceed 75%, though MDNRE observations in August 2009 would support the conclusion that there is virtually 100% storage capacity in soil pores in some layers of the soil during the drier months of the growing season. The model also determines ditch storage capacity based on depths of water measured during 2009 rather than relying on the full height to the top of the ditch banks. Consequently, the conclusion reached with the model that the fields in an unpumped state would not exhibit wetland hydrology is definitive, there is no further basis to delay processing this permit to evaluate the impact of pumping on these fields, and Consumers is not obligated to obtain a Part 303 permit for its planned construction in these fields.

IV. CONCLUSION AND NEXT STEPS

As Consumers has explained in this letter, it is not required to evaluate the farm fields in an unpumped condition to demonstrate the absence of wetland hydrology and wetland vegetation. Part 303 does not exclude pumping from the normal circumstances of these fields, both because it does not mention pumping at all and because it does not regulate these fields in any way. The Army Corps' technical standards that MDNRE must now apply under Part 303 also affirmatively considers the cropped (pumped) condition to be within the normal circumstances of agricultural land like this. The PC cropland determination for these fields, the Army Corps' jurisdictional determination, and Consumers' wetland delineation all support the conclusion that these fields have been effectively drained and activities planned for the fields as part of Consumers' construction project do not need a permit under Part

303. If there were any remaining question regarding the limited use and very limited effects of pumping in these fields, the site visits, historical aerial photographs depicting long-standing non-wetland agriculture, scope and effect calculations concerning the effectiveness of the field tile systems, and the hydrological model all confirm that these fields are not wetlands.

Consumers looks forward to discussing this letter and the attached hydrological model with you very shortly so that permit processing can resume. I would appreciate it if you would please contact Jim Walker (517-788-0428), Environmental Manager for this project, at your earliest convenience to set up the next meeting between MDNRE and Consumers representatives.

Sincerely,

Stephen T. Wawro

Manager, Next Generation

Paper Copies:

MDNRE Bay City District Office

Don Reinke, Army Corps

Electronic Copies:

Elizabeth Brown, MDNRE

Michael Masterson, MDNRE
Todd Losee, MDNRE
James Sallee, MDNRE
Catherine Sleight, MDNRE
Henry Rosenfield, Army Corps
Jim Walker, Consumers
Scott Sinkwitts, Consumers
Don Tilton, ECT
Shoshie Levine, Miller Canfield

17,787,355.4\018544-00068

Exhibit A

USDA Documents

LOCATION PLAN

Pump Capacity = 620 G.P.M.
storage in 16' diameter steel tank =

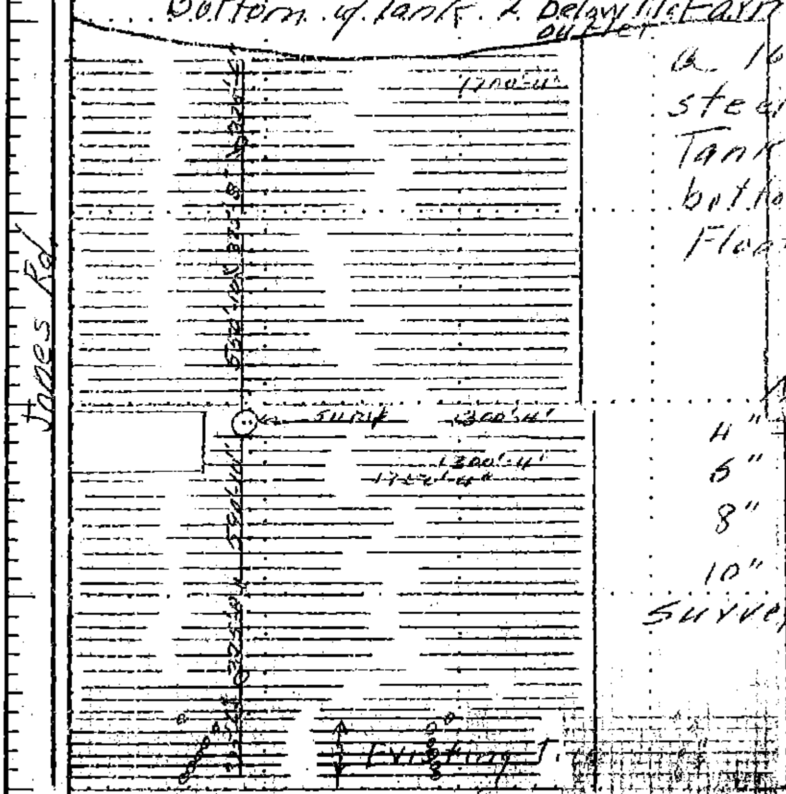
Storage = $\frac{610}{5 \times .75}$ = 165 sq. ft.

$\pi D^2 = 3.1416 \times 64$
$= 200$ sq. ft.

Bottom of Tank 2' below Tile outlet

Pump Capacity
G.P.M = 3/8 x .042 x 85 x 448.8
G.P.M = ~~498~~ + ~~10%~~ = ~~470 GPM~~
610 + 10% = 670 G.P.M.

Farmer intends to use a 16' diameter by 8' steel tank
Tank to be punched in bottom & sides to prevent Floating.



Materials.
4" — 77,500'
6" — 650'
8" — 750'
10" — 1140'
surveyed by Contractor

Scale

— LEGEND —

Farm Boundary	
Permanent Fence	
Existing Tile Line	
Proposed Tile Line	
New Tile Installed	
Existing Deep Ditch	
Proposed Deep Ditch	
Existing Shallow Ditch	
Proposed Shallow Ditch	

SECTION 7
TOWNSHIP Hampton RANGE —
COUNTY Bay STATE Mich

COOPERATOR Walraven Bro.
COOPERATING WITH SCS / ACP
SURVEYED BY Jerry S.

CONSTRUCTION REPORT

Date Installed
Contractor
Staked By
Amount

Remarks:

SIGNATURE DATE

Tile DRAINAGE PLAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed Feld Date
Drawn
Traced
Checked
Approved by William S. Field
Title C.E.
Title
Sheet No. of
Drawing No.

USDA-SCS-MILWAUKEE, WIS 1980

ORDER THIS BLANK DATA SHEET BY DRAWING NUMBER 3-L-45875

ELEVATIONS

STATIONS

DESIGN DETAILS

LINE	STATIONS	DRAIN AREA	DITCH DIMENSIONS				TILE SIZE	GRADE	DRAIN COEF. OR CURVE	VELO- CITY	CAPACITY	
			DEPTH	TOP	BOTTOM	SIDE SLOPE					REQ'D	AVAIL.
		ACRES	FEET	FEET	FEET		INCHES	%		Ft/Sec.	c.f.s.	c.f.s

REGULAR INSPECTION OF THE DRAIN SYSTEM IS ESSENTIAL. PROMPT REPAIR OF ANY FAILURE WILL KEEP THE SYSTEM IN WORKING ORDER AND MAINTENANCE COSTS LOW.

Bench Mark Description:

Materials:

USDA-SCS MILWAUKEE, WIS. 1959

USE THIS SHEET FOR MINOR JOBS ONLY

K-7
2DD197
3 Tracts

Form MI-100
Rev. 6-61

TILE INSTALLATION DATA

Job Name ARThuR WALRAVeN
Section ______ Township HAMpTON County BAY

This report covers tile installation which was made according to current ACP specifications for tile drainage.

On jobs where there is a question of meeting specifications call the Soil Conservation Service Office before starting construction.

Return completed form to SCS office as soon as job is completed.

TILE INSTALLATION DATA

Mains and Single Lines						Outlet Pipe				
Main or Line	Tile Size	Drain Area	Drain Coeff.	Grade	Length	Kind	Size Diam.	Size Length	Rodent Guard	Vert.* Clear.
	Inches	Acres	Inches	Ft/100	FT ~~Rods~~	Mat'l.	Inches	Feet	No.	Inches
Main B	6			10%	600		OLD	MAIN		
EXISTING MAIN										

Laterals
Total Length 4" 20750 FT ~~Rds~~.
Total Length 5" ______ Rds.
Min. grade 4" 10% Ft/100 Ft.
Min. grade 5" ______ Ft/100 Ft.
Min. Cover 24 Inches

Type of blinding or filter used BACKfiller
Area Tiled this year 30 Ac.
Tile spacing 66 Ft.
Type fittings used MANUF.
Tile Manufactured by InTeRLoch PLASTic

*Vertical Clearance - distance from low water in ditch to bottom of outlet pipe.

I certify that this report is correct. Tile were installed in the location shown on the sketch on reverse side. Sept. (Month) 1975 (Year)

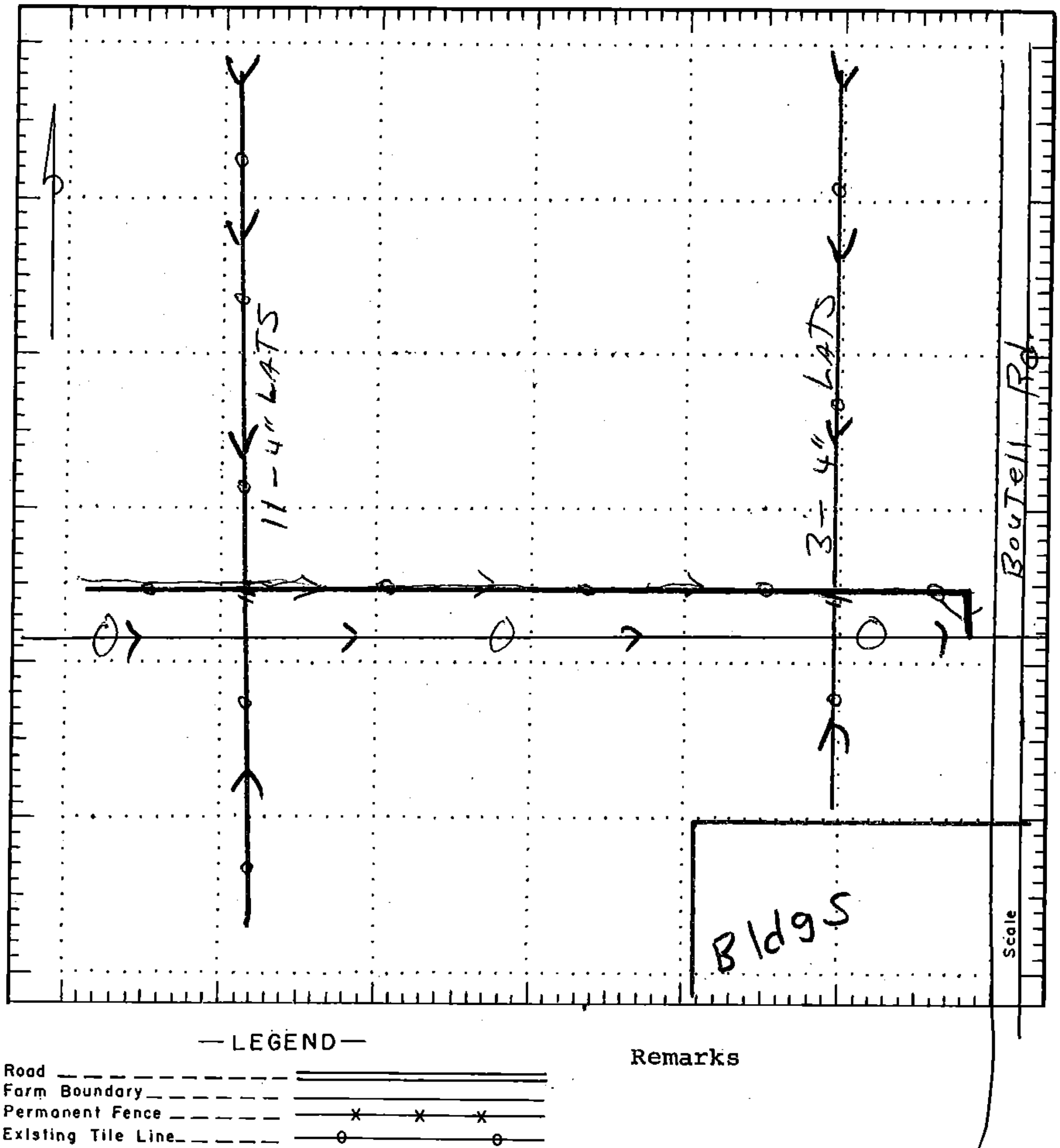
By Arthur Walraven 12-11-75
Signature of owner or operator Date

By Gerald Lou 12-10-75
Signature of Contractor Date

Form MI-100
Rev. April 1961

United States Department of Agriculture
Soil Conservation Service

TILE DRAINAGE PLAN



— LEGEND —

Road
Farm Boundary
Permanent Fence
Existing Tile Line
Proposed Tile Line
New Tile Installed
Existing Deep Ditch
Proposed Deep Ditch
Existing Shallow Ditch
Proposed Shallow Ditch

Remarks

USDA-SCS-LINCOLN NEBR. 1964

Form MI-100
December 1957

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Bay City, Michigan

TILE INSTALLATION RECORD

Please furnish the following information, sign and return to the above address: Bayside Farm

Job Name Walraven Bros County Bay ACP No.

Section 7 Township Hampton

How many mains were installed? One

	TILE MAINS: *Show length in rods & fall per 100 feet.*										OUTLET PIPES		
MAIN	12"	Grade	10"	Grade	8"	Grade	6"	Grade	5"	Grade	Size	Length	Kind
A			18	0.10+%	48	0.10+%	12	0.10%			10"	14'	C.M.P.
B													
C													
D													
E													

Do any laterals empty directly into open ditch? No How many? —

If yes, each lateral is protected with — ft. of — in. of — outlet pipes.

Distance from bottom of outlet pipe(s) to low water level in ditch 1+ ft.

Are all outlet pipes protected with rodent guards? yes

Do all laterals have an average 3 ft. (4 ft. in muck) trench depth? yes

If tile system is in muck soil, were 2 ft. lengths used? —

Are there any tile with less than 2 ft. of cover or over 6 ft. of cover? no

If "yes," show location(s) on sketch by symbol (*)

Do any 4 in. laterals have less than 0.1 ft. or 1-1/4 in. of fall per 100 ft.? no

Do any 5 or 6 in. laterals have less than .07 ft. or 7/8 in. of fall per 100 ft.? no

Are any 4 in. laterals over 80 rods long? no

If "yes," do they have 0.3 ft. or 3-5/8 in. fall per 100 ft.? —

Were any areas of fine sand and silt encountered in trenching? no If "yes," what precautions were taken to protect the tile in these areas (such as straw, tarpaper, fiberglass, etc.)? —

Total acres tiled this year. 50 Average spacing 66 ft.

Is there a soil and water conservation plan for this land?

TOTAL TILE INSTALLED THIS YEAR

Size	Rods	Manufacturer
4"	1697	Mich Vit Tile Co
6"	12	Valley Tile Co
8"	48	" " "
10"	18	Linwood Tile Co

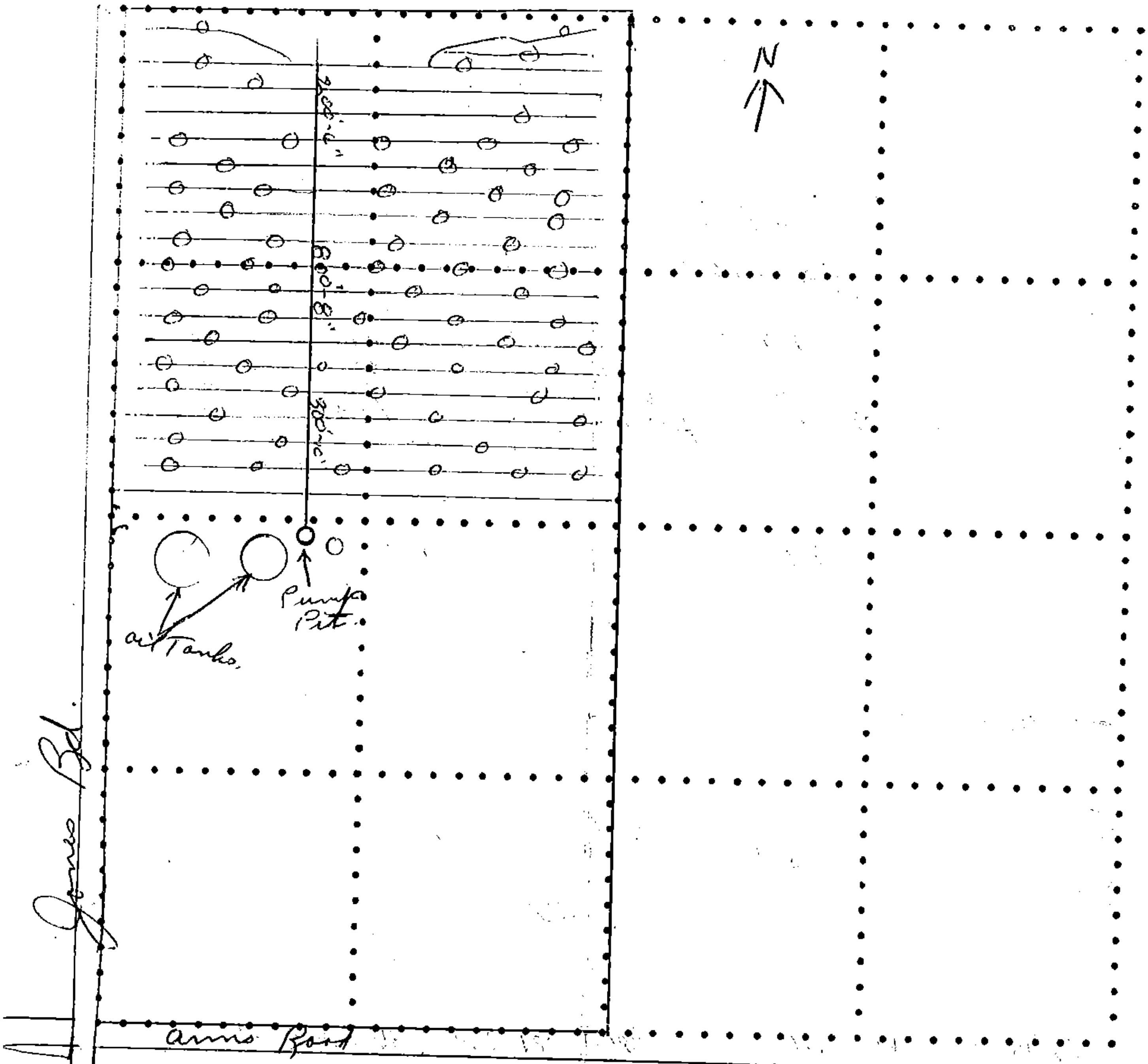
I certify that this report is correct. Tile were installed Nov (Month) 65 (Year) in the location shown on sketch on reverse side.

By: Walraven Bros Alex Walraven Jr
(Signature of owner or operator & date)

By: P L Sansburn Nov 30/65
(Signature of Contractor & date)

NOTE: (Make sketch and remarks on reverse side)

Form MI-100
MI-ST-733(1)



Distance between dots equals __________ rods. If block above is to represent 10 acres then the distance between dots equals 1 rod; if 40 acres, then distance between dots equals 2 rods; if 160 acres, then distance between dots equals 4 rods.

Legend

Farm Boundary
Fence Line
New tile line
Deep Open Ditch
Shallow Open Ditch

Show direction of North.

Show roads, farm buildings, ditches, etc. where applicable. Draw in tile lines to approximate scale and label sizes and lengths. Scattered ground elevations or rod shots would be very helpful in showing slope of field

SOIL CONSERVATION SERVICE
Court House
Bay City, Mich.

CERTIFICATION OF TILE INSTALLATIONS

M[illegible] sketch of tile layout on reverse side of this form

Under the provisions of the Agricultural Conservation Program administered by the Agricultural Stabilization Committee it is the responsibility of the Soil Conservation Service to check technical adequacy or permanent practices to determine whether or not they meet required specifications.

It is the responsilility of the farmer or landowner to have this form completely filled out by the trencher, signed, and returned to the above address within 15 days after the tile are installed.

Tile Main

Rods	Size	Fall per 100 feet	average cut in feet
104-R -	6"	0.08%.	3'+
51-R -	8"	0.1%.	3'+

Cover of main at shallowest point 2'+ feet.
Outlet-pipe 12 feet long and 8 inches in diameter.
Distance from bottom of outlet pipe to low water level in ditch 2' feet.
Is outlet pipe protected with Rodent Control Device? yes

Tile Laterals

Number	Lenght in rods	Fall per 100 feet	Size of main at connection
12 -	Prox 48	0.1+%	8"
8	" 49	0.1+%	6"

Average depth of laterals: 3'+ feet.
Are there any laterals with less than 2 feet of cover at the shallowest point? no
If any laterals outlet directly into ditch, how many no, kind of pipe ____
what size pipe ________, lenght of pipe ____ ft.

Are outlet pipes protected with Rodent control Devices? ________

Were any areas of fine sand or silt encountered in the trench ? no
What precautions were teken to protect the tile in this area (such as straw, tar paper tec. ________

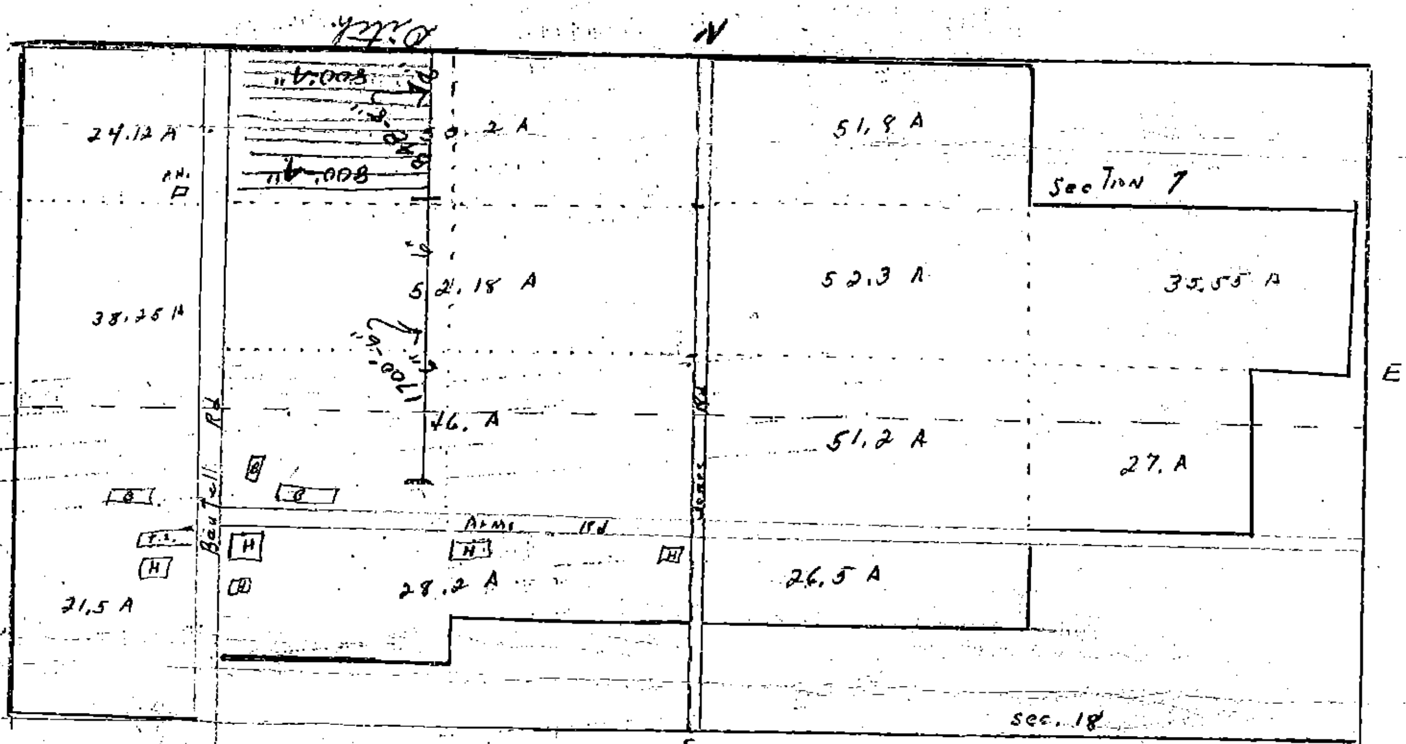
Total acres tiled this year 25 A. Average spacing in rods 4

Remarks:
Outline farm on reverse side of page and indicate in which field the tile system was installed this year. If tile main was installed previously, do not include lenght in total figures above, but show location on map.

SKETCH MAP

Locate farm outline, roads, and farm buildings in relation to tile system.

County Bay Township Hampton Section 12



Sec. 13

The above amount of tile were installed during april 57
month year

I certify that the above information is correct/

Signature of Contractor G. L. Sanshum date Nov. 27/57

Certification of tile Installed:

Amount-feet	Size	Date of purchase	Name of Manufacturer
16000	4"	april 57	[illegible]
1700	6"	"	"
800	8"	"	"

Were these tile certified by manufacturer to meet strength and absorption tests required for payment? ____________

I certify that the above tile purchase information is correct.

Signature of Owner Walraven Bros, Vern J Walraven

Address R #1 Essexville, Mich

date 12-12-57

NOV 2 5 1960

Form MI-100
December 1957

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Bay City, Michigan

TILE INSTALLATION RECORD

1961

Please furnish the following information, sign and return to the above address:
Job Name Walraven Bros County Bay ACP No. K-72
Section ______ Township Hampton 19
How many mains were installed? One

	TILE MAINS:	*Show length in rods & fall per 100 feet.*									OUTLET PIPES		
MAIN	12"	Grade	10"	Grade	8"	Grade	6"	Grade	5"	Grade	Size	Length	Kind
A					75R	0.07%	26R	0.07%			10"	14'	Nelson
B													
C													
D													
E													

Do any laterals empty directly into open ditch? no How many? ——
If yes, each lateral is protected with —— ft. of —— in. of —— outlet pipes.
Distance from bottom of outlet pipe(s) to low water level in ditch 1+ ft.
Are all outlet pipes protected with rodent guards? yes
Do all laterals have an average 3 ft. (4 ft. in muck) trench depth? yes
If tile system is in muck soil, were 2 ft. lengths used? ——
Are there any tile with less than 2 ft. of cover or over 6 ft. of cover? no
If "yes," show location(s) on sketch by symbol (*)
Do any 4 in. laterals have less than 0.1 ft. or 1-1/4 in. of fall per 100 ft.? no
Do any 5 or 6 in. laterals have less than .07 ft. or 7/8 in. of fall per 100 ft.? ______
Are any 4 in. laterals over 80 rods long? no
If "yes," do they have 0.3 ft. or 3-5/8 in. fall per 100 ft.? ——
Were any areas of fine sand and silt encountered in trenching? no If "yes," what precautions were taken to protect the tile in these areas (such as straw, tarpaper, fiberglass, etc.)? ——
Total acres tiled this year. 25 ac. Average spacing 50 ft ft. ——
Is there a soil and water conservation plan for this land? ______

TOTAL TILE INSTALLED THIS YEAR

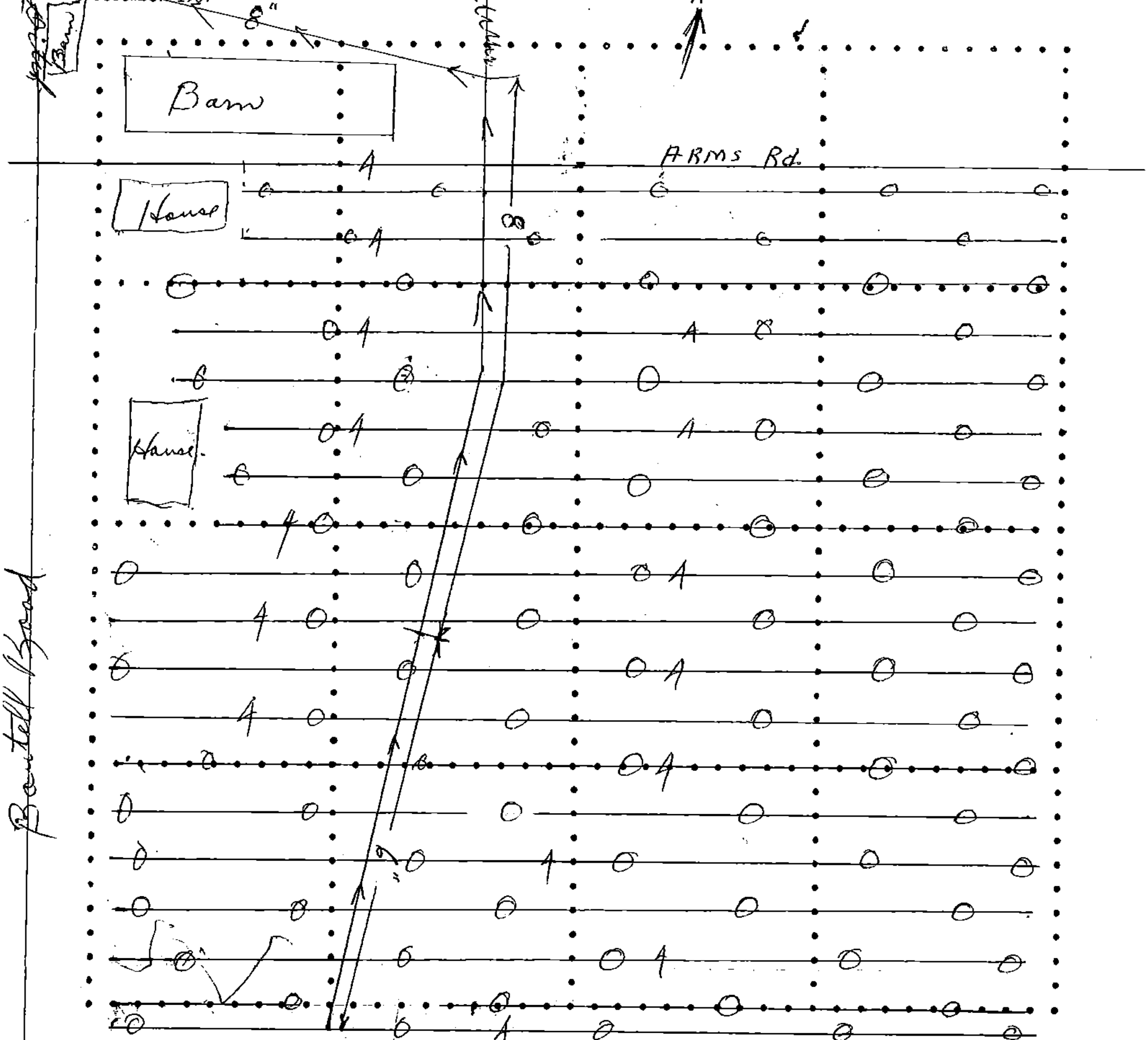
Size	Rods	Manufacturer
8"	75R	Valley Tile Co
6"	26R.	" " "
4"	1135R.	" " "

I certify that this report is correct. Tile were installed Oct (Month) 1960 (Year) in the location shown on sketch on reverse side.

By: Walraven Bros Vern J Walraven (*Signature of owner or operator & date*)
By: C. H. Sanshurn Oct 25/60 (*Signature of Contractor & date*)

NOTE: (Make sketch and remarks on reverse side)

Form MI-100
MI-ST-733(1)



Distance between dots equals 50' rods. If block above is to represent 10 acres then the distance between dots equals 1 rod; if 40 acres, then distance between dots equals 2 rods; if 160 acres, then distance between dots equals 4 rods.

Legend

Farm Boundary

Fence Line

New tile line

Deep Open Ditch

Shallow Open Ditch

Show direction of North.

Show roads, farm buildings, ditches, etc. where applicable. Draw in tile lines to approximate scale and label sizes and lengths. Scattered ground elevations or rod shots would be very helpful in showing slope of field

Form MI-100
December 1957

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Bay City, Michigan

TILE INSTALLATION RECORD

Please furnish the following information, sign and return to the above address:

Job Name Walrauer Bros County Bay ACP No.

Section Township Hampton

How many mains were installed? 2

TILE MAINS: Show length in rods & fall per 100 feet.											OUTLET PIPES		
MAIN	12"	Grade	10"	Grade	8"	Grade	6"	Grade	5"	Grade	Size	Length	Kind
A													
B													
C													
D													
E													

Do any laterals empty directly into open ditch? no How many? —

If yes, each lateral is protected with — ft. of — in. of — outlet pipes.

Distance from bottom of outlet pipe(s) to low water level in ditch 2 ft.

Are all outlet pipes protected with rodent guards? Yes

Do all laterals have an average 3 ft. (4 ft. in muck) trench depth? yes

If tile system is in muck soil, were 2 ft. lengths used? —

Are there any tile with less than 2 ft. of cover or over 6 ft. of cover? no

If "yes," show location(s) on sketch by symbol (*)

Do any 4 in. laterals have less than 0.1 ft. or 1-1/4 in. of fall per 100 ft.? no

Do any 5 or 6 in. laterals have less than .07 ft. or 7/8 in. of fall per 100 ft.? no

Are any 4 in. laterals over 80 rods long? no

If "yes," do they have 0.3 ft. or 3-5/8 in. fall per 100 ft.? —

Were any areas of fine sand and silt encountered in trenching? no If "yes," what precautions were taken to protect the tile in these areas (such as straw, tarpaper, fiberglass, etc.)? —

Total acres tiled this year. 80 Average spacing 50' ft.

Is there a soil and water conservation plan for this land?

TOTAL TILE INSTALLED THIS YEAR

Size	Rods	Manufacturer
4"	958	Mich Vit. Tile Co
6"	38	" " " "
8	95	" " " "
10	77	" " " "

I certify that this report is correct. Tile were installed Oct. (Month) 66 (Year) in the location shown on sketch on reverse side.

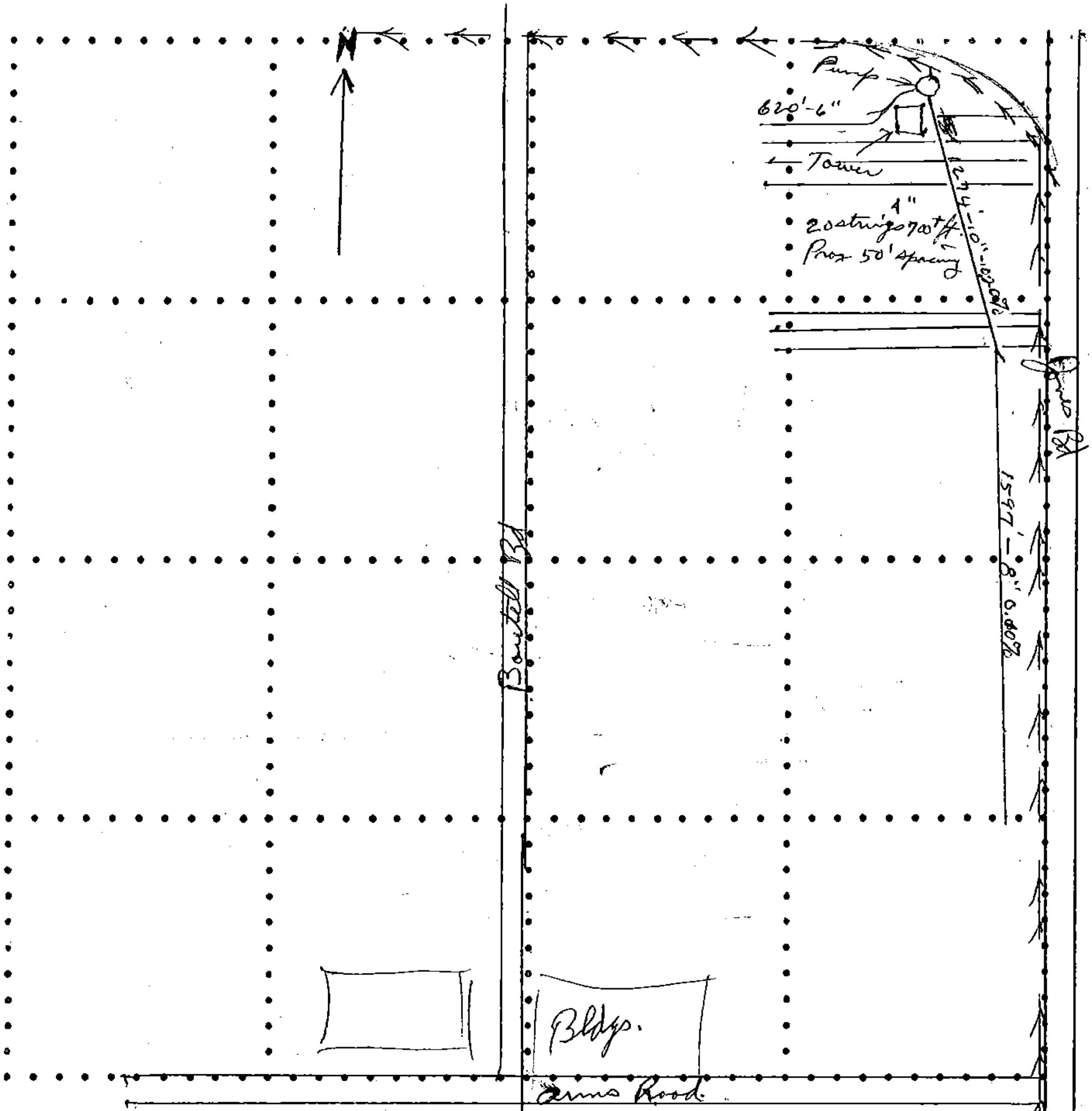
By: Arthur Walrauer
(Signature of owner or operator & date)

By: G. L. Sansburn Dec 9 1966
(Signature of Contractor & date)

Walrauer Bros.

NOTE: (Make sketch and remarks on reverse side)

Form MI-100
MI-ST-733(1)



Distance between dots equals ___6___ rods.
block above is to represent 10 acres then the distance between dots equals 1 rod; If 40 acres, then distance between dots equals 2 rods; if 160 acres, then distance between dots equals 4 rods.

Legend

Farm Boundary
Fence Line
New tile line
Deep Open Ditch
Shallow Open Ditch

Show direction of North.

Show roads, farm buildings, ditches, etc. where applicable. Draw in tile lines to approximate scale and label sizes and lengths. Scattered ground elevations or rod shots would be very helpful in showing slope of field

K-7
2DD197
3 Tracts

Exhibit B

EPA Letter (1997)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUN 2 6 1997

REPLY TO THE ATTENTION OF:

WW-16J

Peg Bostwick
Section 404 Coordinator
Land and Water Management Division
Michigan Department of Environmental Quality
P.O. Box 30028
Lansing, Michigan 48909

Dear Ms. Bostwick:

In a recent conversation, you asked for a clarification of the U.S. Environmental Protection Agency's policy on Clean Water Act (CWA) jurisdiction on agricultural areas from which water is pumped to facilitate crop production. We have discussed this issue with our headquarters office and offer the following clarification.

The areas of concern are croplands on the lake plain of Lake Michigan on which the water table is annually lowered by pumping to facilitate crop production. It appears that but for the annual pumping, the areas would regularly exhibit wetness sufficient to meet the wetland hydrology criteria for CWA jurisdiction.

It is EPA's long-standing policy that temporary and reversible pumping does not remove CWA jurisdiction from an area. If an area would meet wetland hydrology criteria but for the removal of water by pumping, then the area is subject to CWA jurisdiction, provided, of course, that the area also has hydric soils and would, under normal circumstances support hydrophytic vegetation. In the implementation of this policy to exert CWA jurisdiction on a pumped area, the assertion that but for the pumping the area would demonstrate wetness sufficient to meet wetland hydrology criteria should be based on reliable records of the hydrologic condition of the area prior to pumping or a site-specific hydrologic analysis that demonstrates that, if pumping were to cease, the area would meet wetland hydrology criteria.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL	# of pages ▸
To Peg Bostwick	From S. Elston
Dept./Agency	Phone #
Fax # 517 373-9965	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

I hope this information helps to clear up any questions you may have regarding this matter. If you have any additional questions please feel free to call me at 312/886-6115.

Sincerely yours,

Sue Elston

Sue Elston
Regional Wetland Coordinator

cc: Terry Heatlie, Detroit Corps of Engineers

Exhibit C

The Effect of Pumping on Water Levels in Several Farm Fields in Bay County, Michigan (March 2010)

The Effect of Pumping on Water Levels in Several Farm Fields in Bay County, Michigan

By

Environmental Consulting & Technology, Inc.
2200 Commonwealth Blvd., Suite 300
Ann Arbor, Michigan 48105

March 29, 2010

Executive Summary

Consumers Energy used a hydrological model employing a water balance approach to estimate the level of water in certain farm fields in Bay County Michigan that do not exhibit wetland hydrology or wetland vegetation and, therefore, fail to meet the definition of a wetland under Part 303 of the Michigan Natural Resources and Environmental Protection Act, MCL 324.30301(1)(w). These farm fields are influenced by numerous physical features that prevent soil saturation and inundation, including an extensive series of interior ditches, drains under the authority of the Bay County Drain Commissioner, field tiles, levees, and surface water runoff diversion. The fields are also influenced by natural features and water loss mechanisms, such as permeable soils, groundwater recharge, evaporation, and evapotranspiration.

This conservative analysis shows that if all of the water pumped from the ditch and drain system around these farm fields during the non-growing season were left on the fields, i.e., was not removed by pumping, the water level in the soil would not reach within twelve (12) inches of the surface for a period of 14 consecutive days during the growing season. In other words, this analysis supports the conclusion that the physical features, natural features, and natural water loss mechanisms have resulted in the long-term effective drainage and historical elimination of characteristics that are essential to the determination that the fields are wetlands: wetland hydrology and wetland vegetation. The analysis used to reach this conclusion is supported by the materials cited, conservative assumptions regarding physical characteristics of the soil, the verification of pump flow rates, an additional site visit to confirm soil permeability, recent MDNRE guidance adopting similar calculations for use in permitting, as well as the prior converted cropland determination by the Natural Resources Conservation Service and a recent jurisdictional determination by the U.S. Army Corps of Engineers issued on January 6, 2010.

Introduction

The purpose of this report is to evaluate the impact of pumping on water levels in several farm fields located in Bay County Michigan. The fields were determined to be prior converted cropland by the NRCS and the U.S. Army Corps of Engineers confirmed that the fields were not wetlands in a Jurisdictional Determination issued on January 6, 2010.

The farm fields are located in Bay County and aerial photographs show that they have been in active continuous agriculture since at least the 1930's and some of the fields were developed for agriculture prior to that. All of the fields are tiled with subsurface tiles in order to provide for subsurface drainage. The outlet for the subsurface drainage is an open drainage ditch that surrounds the fields. Some of the drainage ditches have a pump that is used to remove surplus water from the fields in preparation for agriculture by pumping water into drainage ditches maintained by the Bay County Drain Commission.

The Michigan Department of Natural Resources and Environment (MDNRE) requested that Consumers present evidence that the agricultural fields would not exhibit wetland hydrology if the pumps were not operational. MDNRE presented two options for presenting this evidence and left the choice to Consumers regarding which option to choose. Those two options acceptable to the MDNRE to complete this task are:

1. Groundwater Monitoring
2. Water Balance Model

Consumers Energy is providing this water balance model because the data can be gathered, analyzed, and presented much sooner and, at significantly less cost than the groundwater monitoring option. Additionally, unlike groundwater monitoring, this model can be prepared without disruption to ongoing farming activities in the area, and without risk of affecting drainage for area homes and businesses outside the project area.

In order to satisfy the MDNRE request, Consumers is providing a water budget that answers the following question: If the water that is pumped from the fields during routine agricultural practices were left on the fields, what would be the depth to saturation in the fields? As this report explains, the depth to saturation in the fields would not be within the top twelve inches.

Generally, the water budget for an area is a balance of:

- Precipitation
- Evapotranspiration
- Evaporation
- Surface runoff
- Groundwater flow

However, in this case, the balance of these inputs and outputs is altered by the presence of subsurface drainage systems and perimeter drainage ditches. While the agricultural drainage systems alter the storage volumes somewhat, the volume of water that is pumped from the fields is a measure of the surplus water generated during the non-growing season. Therefore, by measuring or estimating the volume of water removed from the field assuming that this volume is left on the fields in an unpumped condition, and then utilizing the unpumped volume in a water balance model and allocating the volume of water to various storage components, an estimate of the depth of saturation in each of the agricultural fields can be developed. This water balance model does not assign a water storage or loss value to groundwater recharge, evaporation or evapotranspiration, although data concerning the depth of the groundwater table and regional climactic conditions suggest that these mechanisms would remove substantial volumes of water if water were left on the fields instead of being pumped as part of agricultural production. In other words, were these two factors included in the model, they would likely demonstrate that water levels in the soil would actually fall even lower during the growing season if the fields were left in an unpumped state.

An analogy may be appropriate to understand the basis for the model. Suppose we have a bucket with a known volume of water, for arguments sake, one gallon. The volume of water in the bucket in this analogy represents the volume of water that could be stored in the ditches, tiles and soil in the fields. Furthermore, for this analogy, assume that when the bucket is full that is equivalent to a field with a depth to a water table of less than twelve (12) inches, which would meet the definition of wetland hydrology. Water is removed from the bucket by pumping and the water level in the bucket is lowered. If we pour the water that has been removed from the bucket back into the bucket we will know whether the bucket is full or not. Consumers contends and demonstrates in this model that the bucket would not be full and, therefore, the wetland hydrology definition would not be met.

Methods

The area of each farm field was measured using aerial topographic maps dated 2007.

Soil survey information was obtained from the NRCS web soil survey site (http://websoilsurvey.nrcs.usda.gov/app/). Soil profile information was obtained from the NRCS web soil survey, NRCS Technical Reports and confirmed by site specific information obtained by ECT personnel.

Precipitation data were obtained from the Essexville station and the Palmer Drought index as calculated by National Oceanic Atmospheric Administration.

Dimensions of the drainage ditches were obtained by surveyors and personnel from ECT who performed site specific measurements.

The monthly electric usage of each of the pumps was obtained from Consumers Energy using meter numbers located on the electric meters at each pump. This data is considered conservative as it assumes that the entire electric load for the meter is based on the pump. This is not true for at least one pump – the one located on Boutell Road where the meter records usage in several outbuildings as well as the pump. This analysis also conservatively presumes that the pumps are operating effectively whenever there is electrical usage, which site observations indicate, is not the case all the time. In addition, Consumers personnel spoke directly with local farmers who lease and actually farm the fields with regard to the use, if any, of portable pumps to supplement the electric pumps installed in the field. The farmer who leases the northern field west of Jones Road reported that in the spring of 2009 he used a portable pump for 48 hours. The pumped volume total for the period he used the portable pump was adjusted by adding the estimated volume discharged by the portable pump to the total volume pumped in that period.

Information on the rated horsepower of each pump or pump motor was obtained by inspecting the pumps and obtaining information from the plates on the pumps or from farmer interviews.

Using the rating of the pumps at each pump station, the hours of operation were calculated. To ensure accuracy of the flow volume, the rate of discharge from the pumps was determined using sonic flow meters.

One hundred and sixty one (161) meter readings were recorded in this analysis. Upon reviewing the data, one data point was considered an outlier. At one pump station located west of Jones Road, Consumers and ECT staff as well as MDNRE staff observed during April through September of 2009 that the motor was operating, but water was not being pumped due to a broken fan belt. There was excessive electrical usage during this time period when there was no water being pumped. To obtain an estimate of the volume of water discharged at this location Consumers averaged the increase in pumping from Sept., 2007-May 2008 and Sept., 2008-May, 2009 and calculated an average increase between the two periods. The pumped volume at the pump station for the southwestern field along Jones Road for 2007-2008 was increased by the average amount in the other fields to obtain the estimate of the pumped volume for 2008-2009.

.

Results and Discussion

Precipitation

The precipitation for the period of study (the year 2009) shows that the area had above average precipitation (Table 1). In particular, the precipitation during the months January through April was 52% above average. The Palmer drought index showed that the region was considered "unusually moist" during the period of study (Appendix A). Consequently, if wetland hydrology would exist in the farm fields in the absence of pumping, it could be modeled using data from this period. Using the pumped volume from the fields during a period of above average precipitation is another example of the conservative nature of the hydrologic model.

Table 1. Average monthly precipitation for the period 1971-2000 and 2009 monthly precipitation at the Essexville station.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2009	1.58	3.05	2.46	5.25	2.31	4.04	2.62	3.61	1.05	4.08	0.67	0.86	31.58
Mean	1.77	1.38	2.13	2.84	3.14	3.13	2.41	3.43	3.98	2.69	2.70	1.84	31.44

Soil Characteristics

The soil information obtained from the NRCS is presented in Table 2 (See Appendix B and C for detailed information).

During site visits with MDNRE in the summer of 2009, it was apparent that during excavation of several soil pits to a depth of 24-30 inches below the surface, that the soil below the A horizon or topsoil was hard and difficult to excavate using hand shovels. The clogs that that were obtained from holes dug in the field were hard and difficult to crumble. Based on these field conditions, MDNRE developed a hypothesis that the B horizon may be a shallow aquitard, which would allow shallow perched water conditions to exist in the farm fields that would constitute wetland hydrology in the absence of pumping. However, upon further study and data collection of representative conditions, it is clear that soil conditions observed in the farm field in the summer of 2009 were localized temporary conditions caused by the drainage system and climatic conditions at the time of the study. The following information and data, which are representative of normal soil conditions of the site, provide a significantly different picture of soil conditions in the farm fields compared to the observations made in the summer of 2009.

The soil survey descriptions for these soil types indicate that the soil profile lacks an aquitard. The Interim Regional Supplement to the Army Corps of Engineers Manual: North Central and Northeast Region defines **Aquitard** as *"a layer of soil or rock that retards the downward flow of water and is capable of perching water above it. For the purposes of this supplement, the term aquitard also includes the term aquiclude, which is a soil or rock layer that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients."* The soil profiles for the soils in the farm fields indicate that there are no rock layers to a depth of 80 inches. The soil survey descriptions indicate that there may be a layer of loam or sandy loam below the A horizon, that is relatively more impermeable than the surface, but the NRCS has classified the saturated hydraulic conductivity of these layers as "Moderately High". The underlying soil is considered a loam or sandy soil at various depths below the surface and the physical properties of the soil are such that water is not perched above the soil layer. Thus, the sandy loam and loam soils which comprise the soils below the A horizon in these farm fields have a moderately high saturated hydraulic conductivity and are not capable of perching water in the A horizon and thus do not constitute an aquitard. Furthermore, the presence of a subsurface tile system effectively prevents any perched water from accumulating in the A horizon of the farm fields. Moreover, if an aquitard existed at 12 inches below the soil surface, it would prevent significant amounts of water from penetrating to lower depths. Many of the fields have been successfully planted with corn, whose roots normally extend to a depth of approximately four feet or more and require adequate moisture at such a depth. Thus, the successful growth of corn on these fields for many decades further substantiates that a significant amount of water penetrates to four feet or more below the surface and that the soil above this depth is not acting as an aquitard.

Table 2. The area of soil types present in various fields located in Bay County.

Field Location	Essexville loamy sand	Tappan loam	Wixom loamy sand	Total Acres
West of Jones Rd., Northern field	58	23	0	81
West of Jones Rd.,Southern field	0	71	3	74
West of Boutell Road	0	40	4	44
East of Jones Road	43	200	0	243
East of Weadock	6	118	4	128

More evidence that the Essexville loamy sand and Tappan loam lack an aquitard near the surface of the soil comes from a technical report on the physical characteristics of the soils in Tuscola County, which is the county immediately to the east of Bay County. The study reports on over 60 physical characteristics of various profiles of various soil types to a depth of 160 centimeters. The results of the percentage of silt, clay, and sand are summarized in Table 3 and support the conclusion that, due to the substantial percentage of sand at all soil depths; the surface soil profiles lack an impermeable layer that retards the movement of water.

Table 3. The proportion of clay, silt and sand on a percentage basis for two soils found on the Consumers site. From "Characterization data for selected soils of Tuscola County, Michigan" Research Note 33. Michigan Technological University. 1984

Soil Series	Depth from surface(cm)	Clay (%)	Silt (%)	Sand (%)
Tappan loam	0-22	25.2	20.2	54.6
	22-29	18.7	27.5	53.8
	29-45	25.6	30.4	44.0
	45-160	22.8	36.9	40.3
Essexville loamy sand	0-30	2.9	11.9	85.2
	30-45	1.4	5.7	92.9
	45-69	0	2.0	98.0
	69-85	0.9	1.2	97.9
	85-160	33.4	46.6	20.0

Further evidence that an aquitard does not exist near the surface of these farms fields is provided by the NRCS. Saturated hydraulic conductivity, which is a key indicator of the permeability of a soil layer, refers to the ease with which pores in a saturated soil transmit water. The estimates provided by the NRCS (http://websoilsurvey.nrcs.usda.gov/app/) are expressed in micrometers per second for a particular depth within the soil. The saturated hydraulic conductivity for the three soil types in the fields at a depth between 10 and 40 inches were as follows:

Essexville loamy sand = 54 micrometers/second
Wixom loamy sand = 54 micrometers/second
Tappan loam = 4 micrometers/second

The NRCS has also provided standard classes of saturated conductivity ranging from very low to very high. Using the standard class system developed by NRCS the Essexville loamy sand and Wixom loamy sand would be placed in the "High" class and Tappan loam would be placed in the "Moderately High" class. The saturated hydraulic conductivity of the soil types comprising the subsurface soil at these farm fields clearly indicates the absence of an aquitard.

During the meeting with MDNRE staff on February 26, 2010, MDNRE staff requested that the depth of the A horizon be measured at various locations in the farm fields. In response to the request by MDNRE, soil information on the depth of topsoil and underlying soil to a depth of 30 inches was collected on March 16, 2010. The results (Table 4) show that the depth of topsoil or A horizon varied with various field locations. The results also show that the underlying soil was consistent with the soil survey description for the farm fields and consisted of loamy sands and loam soils having high or moderately high saturated hydraulic conductivity.

Table 4. Depth of the A horizon (topsoil) and underlying soil type at various locations in the farm fields.

Field Location	Depth of A Horizon (topsoil) inches	Depth and type of underlying soil (inches)	Sample Location
West of Jones Rd., Northern field	0-9 inches, dark sandy loam	9-30 inches loam	At the northwest corner of the field across from the private drain, 50 feet south of the drain and 50 feet west of the drain.
West of Jones Rd., Southern field #1	0-20 inches dark loamy sand	20-30 inches loam	North of Arms Road 50 feet and west of farm access road 50 feet. In south east corner of the field
West of Jones Rd., Southern field #2	0-17 inches, dark sandy loam	17-30 inches loam	North of the service building 100 feet and east of Boutell
West of Boutell Road	0-15 inches, dark sandy loam	15-30 inches loam	100 feet west of the opening of the Tacey Drain
East of Jones Road, north	0-12 inches, dark sandy loam	12-20 inches sand, 20-30 inches loam	East of Jones Road, 25 feet of third telephone pole leading to oil pump. Approx. 200 feet north from oil storage area
East of Jones Road, south	0-12 inches, dark sandy loam	12-30 inches loam	East of Jones Road, 100 feet east of private drain and 25 feet south of the small drain leading from field pump
East of Weadock	0-13 inches dark sandy loam	13-27 inches loam, 27-30 inches sandy loam	100 feet east of the manhole in the southern portion of the field

In summary, the NRCS soil survey data show that the farm fields are comprised of Tappan loam, Essexville loamy sand and Wixom loamy sand and the soil survey information was confirmed during field surveys during 2008, 2009 and 2010. Furthermore NRCS data show that the subsurface soil for the Tappan loam is approximately 40-50% sand and the subsurface soil for Essexville and Wixom soils were in excess of 90% sand, which was confirmed by ECT personnel, which renders these soils incapable of retarding the downward flow of water and perching water in the upper layer. Equally important, NRCS has classified the Essexville loamy sand and Wixom loamy sand as having high saturated hydraulic conductivity and the Tappan loam as having moderately high saturated hydraulic conductivity, which means that these soils are capable of transmitting significant quantities of water and cannot be defined as aquicludes. Based on the aforementioned NRCS data, and field surveys to confirm the NRCS data, there is no factual basis on which to conclude that these soils act as aquitards and perch water in the upper i2 inches of the soil column. To the contrary, these data demonstrate that the soils in the farm fields are able to store water in soil pore space at a considerable depth below the top twelve inches relevant to determining the existence of wetland hydrology. Moreover, the absence of an aquitard in the upper 12 inches of soil is further confirmed by the existence of a tile drainage system approximately 24-30 inches below the surface that effectively drains water from the overlying soil.

Pump Discharge
The monthly volume of water pumped from the various farm fields is presented in Table 5.

Table 5. Volume of water pumped from drainage ditches at several farm fields.

Field Location	Volume of Water Pumped Sept., 2008-May, 2009 (gallons)	Volume of Water Pumped Sept., 2007-May, 2008 (gallons)
West of Jones Rd., Northern field	4,470,000	2,560,000
West of Jones Rd.,Southern field	7,280,000*	5,110,000
West of Boutell Road	930,000	1,500,000
East of Jones Road	18,270,000	6,620,000
East of Weadock	8,880,000	6,690,000

** This value has been corrected due to mechanical failure of the pump.*

The period of pumping was selected because this period represents the months in Michigan when precipitation exceeds evapotranspiration, therefore, water may accumulate in the soil in the fields and drainage systems. Generally, April and May are the months when soil moisture is relatively high compared to the summer months, therefore, an appropriate time to determine soil moisture conditions in the farm fields. Using a period that starts in early spring is another conservative assumption for this model given that the existence of wetland hydrology is determined during the growing season, which does not start until roughly April 28 in Bay County, Michigan.

Water Balance
The water balance of these fields is influenced by the extensive and effective drainage system that has been installed and operated over the years. In an unpumped condition, precipitation would percolate through the soil and collect in the drainage tiles and would drain by gravity into the perimeter drainage ditches. As the drainage ditches fill with water, the water level would eventually rise to a level above the invert of the drainage tiles. At this point the drainage tiles would fill with water as precipitation would continue to percolate through the soil into the drainage tile. As the drainage tiles become saturated water would begin to accumulate in the soil both above and below the drainage tile. Eventually, in the unpumped condition, water would fill the available pore space in the soil and, if there is a sufficient volume of unpumped water, completely saturate the upper soil. When the upper soil profile, drain tiles and perimeter ditches are filled with water, the area would meet the hydrologic criteria for a wetland as long as the saturated condition persisted for 14 days during the growing season. Therefore, if the volume of water pumped from the fields is more than the total volume stored in the tiles, drainage ditch and soil profile, then the area may exhibit wetland hydrology in the unpumped condition. However, if the volume of water pumped from the fields is less than the volume stored in the drain tiles,

perimeter ditch and soil profile, then the unpumped condition does not exhibit wetland hydrology.

This model looks at three storage components in each of the fields (Table 7). Water is stored in the open drainage ditches, the subsurface drainage tiles, and the pore spaces of the soil. The storage volume of the drainage ditches was estimated by measuring the length, width, and depth of the water level in the drainage ditches connected to the pumps. The storage volume of the subsurface drainage tile was estimated by calculating the cross sectional area of the drainage pipe times the length of the drainage pipes in each field. The length of the drainage tiles was estimated using aerial photographs.

The amount of water stored in the soil at field capacity is referred to as the Available Water Supply (AWS). NRCS has calculated the AWS for the soil types in the fields based on various depths of the soil profile (Table 6). The AWS for Tappan loam, Essexville loamy sand and Wixom loamy sand was obtained from the NRCS and used to calculate the storage potential of the upper 40 inches of soil. To calculate the weighted available water supply for each field, the percentage of each soil type in the field was calculated using NRCS soil survey data and a weighted available water supply was calculated based on the percentage of each soil type and the individual available water supply for each soil type. The weighted available water supply for each field was used in the water balance model to determine the available water supply.

Table 6. The available water supply (AWS) in inches at various depths in the soil types found in the farm fields as obtained from the NRCS.

Soil Series	AWS 0-10 in.	AWS 0-40 in	AWS 0-60 in
Essexville loamy sand	1.10	4.81	8.4
Wixom loamy sand	1.10	4.73	8.3
Tappan loam	2.00	6.93	10.4

This model could have used a depth of 0-60 inches based on the 1984 Michigan Techological University soil study in Tuscola County, which observed various factors related to these soil types to a depth of 160 centimeters, which is roughly 63 inches. However, the model used a depth of 0-40 inches in the water balance model because this depth represents the average rooting depths of the crops grown on the fields. Corn and sugar beets tend to be fairly deep rooted crops and these are common crops on the fields. Sugar beets and corn roots can extend six feet below the surface but the majority of the roots are concentrated in the upper 36-48 inches. In January 2010, the Michigan Department of Agriculture issued a document entitled Generally Accepted Agricultural and Management Practices for Irrigation Water Use. In this report the following information regarding rooting depth of corn was provided: **"Corn also has a very good branching root system and can effectively use water to a depth of four feet or more."** Soybean root systems tend to be somewhat shallower compared to corn and sugar beets, but they can penetrate to 36 inches. Additionally, the model assumed that at the end of the growing season the soil would not have lost 100% of the available water supply.

Rather, a more conservative 75% of potential AWS was used based on the soil characteristics observed by ECT personnel in August 2009. As Table 7 shows, even when the potential for water storage in the fields is reduced by using the layer 12-40-inch depth and a 75% of potential AWS, there is still substantial potential storage for water available in the top 12-40 inches of soil in the fields.

The water balance model used in this analysis has several conservative assumptions incorporated into the model. We assumed that the average water supply rooting depth was 40 inches which for some of the crops is an underestimate. We assumed that there would be no groundwater recharge or percolation beyond the 40 inch depth if the pumped water were stored in the fields during the non-growing season. We assumed that there would be no evaporation or evapotranspiration loss from the fields if the water were left on the fields. We assumed that all of the pumps were operating efficiently all of the time despite observations to the contrary during site visits and that the portable pump used for two days in one of the fields operated at maximum efficiency although we were unable to confirm this assumption. Finally, we modeled the water balance for the 2008-2009 seasons during which the precipitation levels were well above average without correcting for the unusually wet soil conditions.

Table 7. Available storage volume in the fields assuming a soil depth between 12 inches and 40 inches and 75% available water supply.

Field Location	Potential Drainage Ditch Volume (gallons)	Potential Drainage Tile Volume (gallons)	75 % of the Potential Available Water Supply (AWS) in the Soil between 12- 40 inches (gallons)	Total Potential Storage Volume (gallons)
West of Jones Rd., Northern field	2,430,000	70,000	6,240,000	8,740,000
West of Jones Rd.,Southern field	1,980,000	60,000	6,760,000	8,800,000
West of Boutell Road	720,000	20,000	3,970,000	4,710,000
East of Jones Road	4,820,000	50,000	19,310,000	24,180,000
East of Weadock	4,000,000	90,000	11,590,000	15,680,000

The difference between the storage volume available in each field and the volume of water pumped from the fields is a measure of the depth of saturation in each field. Table 8 summarizes the volume of water pumped from each field versus the available storage volume available in the drainage system and subsurface soil between 12 and 40 inches of the surface. If the volume of water that was pumped from each field is less than the storage volume of each field, then the field would not have been saturated within twelve inches of the surface and would not have met the definition of a wetland. The data clearly show that the pumped volume was considerably less than the storage volume of each field; therefore the soil would not have been saturated to a depth or duration to satisfy the definition of wetland hydrology if the fields were in an unpumped condition during the growing season.

The water balance was calculated assuming that the total available storage volume was based on drain tiles, perimeter ditches, and available water supply in 12-40 inches of soil and that the initial available water supply in the soil was 75% of the total available water supply (Table 8).

The results of the water balance with the conditions set at a 75% available water supply deficit and a depth to saturation of twelve (12) inches from the surface clearly show that, even with the conservative nature of the model, the pumped volume of water is not large enough to saturate the soil at a depth of twelve (12) inches from the surface. If the water would not reach twelve inches below the soil surface, then it would not inundate or saturate the upper twelve inches and could not constitute wetland hydrology.

Table 8. Comparison of the storage volume available in each farm field assuming 75% available storage in the soil and a depth to saturation of 12 inches.

Field Location	Total Pumped Volume Sept., 2008-May, 2009 (gallons)	Total Pumped Volume Sept., 2007-May, 2008 (gallons)	Total Storage Available assuming 75%AWS and 12-40 inches of soil storage (gallons)	Wetland Hydrology Status
West of Jones Rd., Northern field	4,470,000	2,560,000	8,740,000	Not saturated within 12 in. of the surface
West of Jones Rd.,Southern field	7,280,000*	5,110,000	8,800,000	Not saturated within 12 in. of the surface
West of Boutell Road	930,000	1,500,000	4,710,000	Not saturated within 12 in. of the surface
East of Jones Road	18,270,000	6,620,000	21,630,000	Not saturated within 12 in. of the surface
East of Weadock	8,880,000	6,690,000	15,680,000	Not saturated within 12 in. of the surface

* This value has been corrected due to mechanical failure of the pump.

Conclusion

Using NRCS data and field investigations of soil conditions in the farm fields to confirm the NRCS, the soils lack evidence of an aquitard in the soil. Indeed, the NRCS data show that the subsoil to a depth of three feet or more is between 40-50% sand for the Tappan loam and greater than 90% sand for the Essexville and Wixom loamy sands. Moreover, the NRCS has classified the soils in the farm fields as having high to moderately high saturated hydraulic conductivity which indicates that the soils are not an aquitard and cannot perch water in the upper twelve inches of the soil profile.

Using a hydrologic model based on a water balance approach that conservatively modeled the potential storage in ditches, drainage tiles and the upper 12-40 inches of soil, Consumers has shown that the pumped volume removed from farm fields would not have saturated the soils in the farm fields within 12 inches of the surface for 14 consecutive days during the growing season. This conservative analysis did not include water losses and storage associated with soil storage below 40 inches from the surface, loss to groundwater infiltration, evaporation and evapotranspiration, all of which would increase the depth to saturation had these factors, along with other conservative estimates of environmental conditions, been included. In other words, even with the conservative nature of the model, this analysis supports the conclusion that the physical features, natural features, and natural water loss mechanisms have resulted in the long-term effective drainage and historical elimination of characteristics that are essential to the determination that the fields are wetlands: wetland hydrology and wetland vegetation. The analysis used to reach this conclusion is supported by the materials cited, conservative assumptions regarding physical characteristics of the soil, the verification of pump flow rates, an additional site visit to confirm soil permeability, recent MDNRE guidance adopting similar calculations for use in permitting, as well as the prior converted cropland determination by the Natural Resources Conservation Service and a recent jurisdictional determination by the U.S. Army Corps of Engineers issued on January 6, 2010.

APPENDIX A
Palmer Drought Index

Index Category	Level	Condition
-4.0 or less	Extreme Drought	1
-3.0 to -3.9	Severe Drought	2
-2.0 to -2.9	Moderate Drought	3
-1.9 to +1.9	Near Normal	4
2.0 to 2.9	Unusual Moist Spell	5
3.0 to 3.9	Very Moist Spell	6
4.0 and above	Extremely Moist	7

Week of	Condition	Level
3-Jan	7	Extremely Moist
10-Jan	7	Extremely Moist
17-Jan	7	Extremely Moist
24-Jan	7	Extremely Moist
31-Jan	7	Extremely Moist
7-Feb	7	Extremely Moist
14-Feb	7	Extremely Moist
21-Feb	7	Extremely Moist
28-Feb	7	Extremely Moist
7-Mar	7	Extremely Moist
14-Mar	7	Extremely Moist
21-Mar	7	Extremely Moist
28-Mar	7	Extremely Moist
4-Apr	7	Extremely Moist
11-Apr	7	Extremely Moist
18-Apr	7	Extremely Moist
25-Apr	7	Extremely Moist
2-May	7	Extremely Moist
9-May	7	Extremely Moist
16-May	7	Extremely Moist
23-May	7	Extremely Moist
30-May	7	Extremely Moist
6-Jun	6	Very Moist Spell
13-Jun	6	Very Moist Spell
20-Jun	7	Extremely Moist
27-Jun	7	Extremely Moist
4-Jul	6	Very Moist Spell
11-Jul	5	Unusual Moist Spell
18-Jul	7	Extremely Moist
25-Jul	7	Extremely Moist
1-Aug	7	Extremely Moist
8-Aug	7	Extremely Moist
15-Aug	7	Extremely Moist
22-Aug	7	Extremely Moist
29-Aug	7	Extremely Moist
5-Sep	7	Extremely Moist
12-Sep	6	Very Moist Spell
19-Sep	6	Very Moist Spell

26-Sep	6	Very Moist Spell
3-Oct	7	Extremely Moist
10-Oct	7	Extremely Moist
17-Oct	7	Extremely Moist
24-Oct	7	Extremely Moist
31-Oct	7	Extremely Moist
7-Nov	7	Extremely Moist
14-Nov	7	Extremely Moist
21-Nov	7	Extremely Moist
28-Nov	7	Extremely Moist
5-Dec	7	Extremely Moist
12-Dec	7	Extremely Moist
19-Dec	7	Extremely Moist
26-Dec	7	Extremely Moist

APPENDIX B
Soil Maps

Soil Map—Bay County, Michigan
(SW Jones)

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:4,350 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

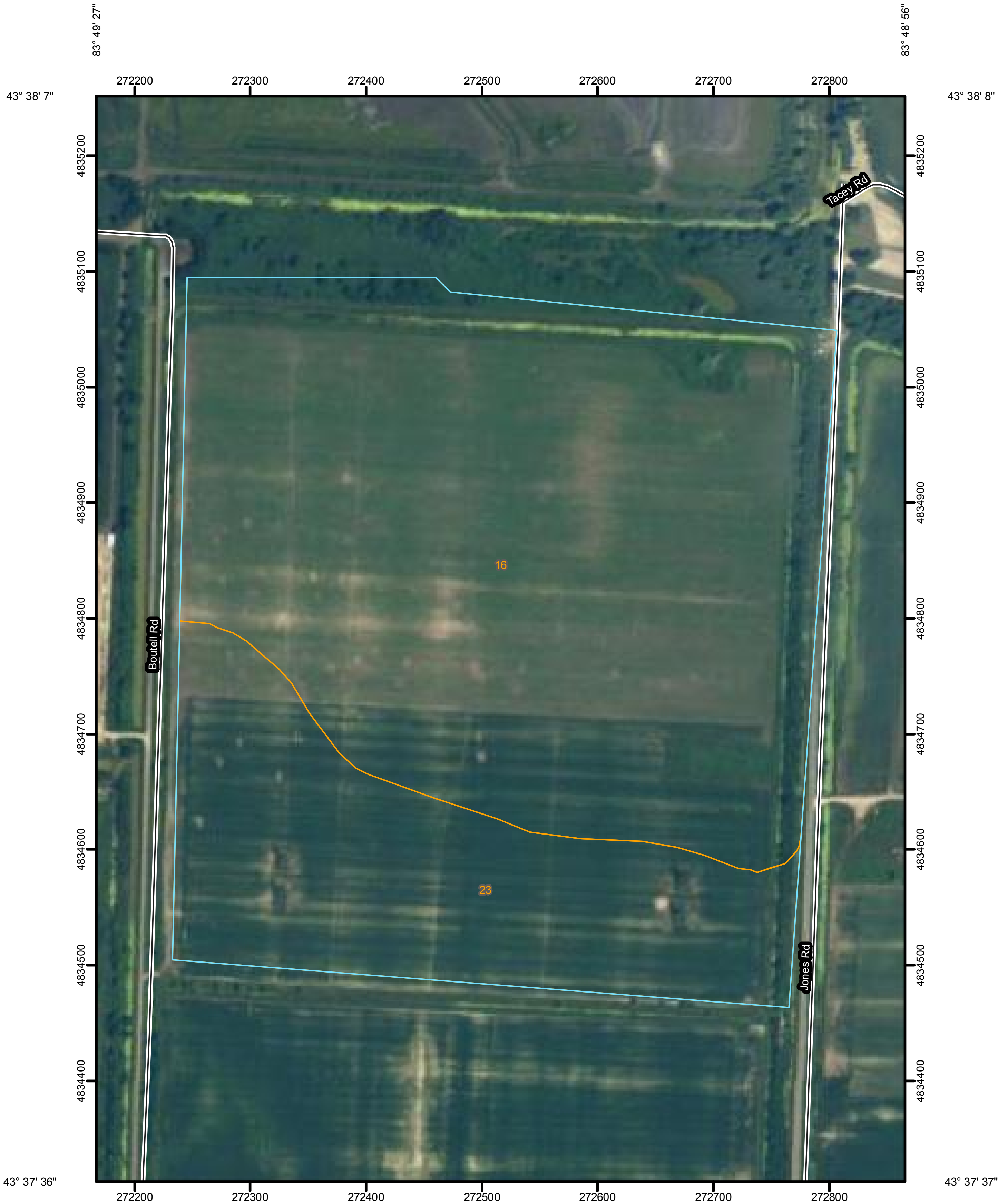
Date(s) aerial images were photographed: 7/10/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

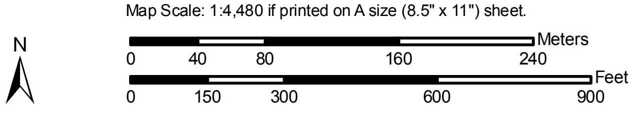
Map Unit Legend

Bay County, Michigan (MI017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
17A	Wixom loamy sand, 0 to 3 percent slopes	2.8	3.8%
23	Tappan loam	70.7	96.2%
Totals for Area of Interest		**73.5**	**100.0%**

Soil Map—Bay County, Michigan
(West of Jones North)



Map Scale: 1:4,480 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,480 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Date(s) aerial images were photographed: 7/10/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Bay County, Michigan (MI017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
16	Essexville loamy sand	57.7	71.7%
23	Tappan loam	22.8	28.3%
Totals for Area of Interest		**80.5**	**100.0%**


83° 50' 8"
83° 49' 32"
271300
271400
271500
271600
271700
271800
271900
272000
43° 37' 50"
43° 37' 51"
4834700
4834600
4834500
4834400
4834300
4834200
4834100
4834000
4833900
4833800
4833700
16
17A
23
56
56
17A
43° 37' 15"
43° 37' 16"
83° 50' 6"
83° 49' 31"
Map Scale: 1:5,160 if printed on A size (8.5" x 11") sheet.
N
Meters
0 45 90 180 270
Feet
0 150 300 600 900

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:5,160 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Date(s) aerial images were photographed: 7/10/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Bay County, Michigan (MI017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
16	Essexville loamy sand	6.3	4.9%
17A	Wixom loamy sand, 0 to 3 percent slopes	1.5	1.2%
23	Tappan loam	120.0	93.6%
56	Dumps	0.4	0.3%
Totals for Area of Interest		**128.3**	**100.0%**

Map Scale: 1:8,740 if printed on A size (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 300, 600, 1,200, 1,800

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:8,740 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Date(s) aerial images were photographed: 7/10/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Bay County, Michigan (MI017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
16	Essexville loamy sand	43.4	17.8%
23	Tappan loam	200.2	82.2%
Totals for Area of Interest		**243.5**	**100.0%**

Soil Map—Bay County, Michigan
(w Boutell)

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,240 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Date(s) aerial images were photographed: 7/10/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Bay County, Michigan (MI017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
16	Essexville loamy sand	0.0	0.1%
17A	Wixom loamy sand, 0 to 3 percent slopes	4.3	9.8%
23	Tappan loam	39.3	90.1%
Totals for Area of Interest		**43.6**	**100.0%**

APPENDIX C
Soil Survey & Map Unit Descriptions

LOCATION WIXOM MI
Established Series
Rev. DEH-WEF-MLK
03/2000

WIXOM SERIES

The Wixom series consists of very deep, somewhat poorly drained soils formed in sandy material and the underlying loamy glacial till or lacustrine sediments. Permeability is rapid in the sandy materials and moderately slow in the loamy materials. Slopes range from 0 to 6 percent. Mean annual precipitation is about 30 inches, and mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Sandy over loamy, mixed, semiactive, mesic Alfic Epiaquods

TYPICAL PEDON: Wixom loamy sand - on a north facing slope of 2 percent in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many roots; strongly acid; abrupt smooth boundary. (6 to 10 inches thick)

E--9 to 14 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; many roots; slightly acid; abrupt wavy boundary. (0 to 6 inches thick)

Bs--14 to 22 inches; dark yellowish brown (10YR 4/4) fine sand; few fine distinct yellowish brown (10YR 5/6 and 5/8) iron accumulations; weak fine subangular blocky structure; friable; common roots; slightly acid; gradual wavy boundary. (4 to 30 inches thick)

E`--22 to 29 inches; pale brown (10YR 6/3) fine sand; common medium distinct yellowish brown (10YR 5/6) and light gray (10YR 7/1) iron depletions; weak medium subangular blocky structure; very friable; few roots; slightly acid; abrupt wavy boundary. (0 to 8 inches thick)

2Bt--29 to 34 inches; dark brown (7.5YR 4/4) sandy clay loam; common medium distinct strong brown (7.5YR 5/6 and 5/8) iron accumulations and pinkish gray (7.5YR 6/2) iron depletions; moderate medium angular blocky structure; firm; few roots; neutral; abrupt wavy boundary. (4 to 14 inches thick)

2C--34 to 60 inches; reddish brown (5YR 4/4) silty clay loam; common medium distinct yellowish red (5YR 5/6 and 5/8) and light reddish brown (5YR 6/4) iron accumulations; massive; firm; slight effervescence; moderately alkaline.

TYPE LOCATION: Midland County, Michigan; about 1 mile southeast of Wixom Lake; 700 feet south and 260 feet west of the northeast corner, sec. 9, T. 16 N., R. 1 E.

RANGE IN CHARACTERISTICS: The depth to the 2Bt horizon ranges from 20 to 40 inches. The sandy part of the solum ranges from strongly acid to neutral. Gravel content ranges from 0 to 5 percent throughout the pedon.

Uncultivated areas have an A horizon, 1 to 4 inches thick, with hue of 10YR or 7.5YR, value of 3, and chroma of 1 or 2. The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. The A and E horizons are sand, fine sand, loamy sand, or loamy fine sand.

The Bs horizon has hue of 10YR to 5YR, value of 3 to 6, and chroma of 2 to 8. It is sand, fine sand, loamy sand, or loamy fine sand. Small fragments of ortstein are in the Bs horizons in some pedons.

The E' horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is sand, fine sand, loamy sand, or loamy fine sand. It is in thick coatings on faces of peds in the upper part of the 2Bt horizon in some pedons.

The 2Bt horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam, clay loam, sandy clay loam, loam, or silt loam.

The 2C horizon has hue of 10YR to 5YR, value of 4 to 6, and chroma of 1 to 4. It is loam, clay loam or silty clay loam.

COMPETING SERIES: There are no other series in this family.

GEOGRAPHIC SETTING: Wixom soils are on till, outwash and lake plains. Slope gradients are dominantly 0 to 3 percent, but range from 0 to 6 percent. They formed in 20 to 40 inches of sandy sediments and in the underlying loamy till or lacustrine sediments. Mean annual precipitation ranges from 28 to 34 inches, and mean annual temperature ranges from 45 to 50 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: Wixom soils are associated in the landscape with the Belleville, Ithaca, and Pipestone soils. The poorly drained Belleville soils are in a drainage sequence with the somewhat poorly drained Wixom soils. Ithaca soils are on areas where the sandy materials are less than 20 inches thick. The Pipestone soils are on areas where the sandy sediments are thicker than 40 inches.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. Potential surface runoff negligible or very low. Permeability is rapid in the sandy material and moderately slow in the loamy material.

USE AND VEGETATION: About 80 percent of this soil is cultivated or is in pasture. The remainder is in woodland. Corn, oats, wheat, and legume hay are the major crops. Native vegetation was mixed hardwood, predominantly American elm, white ash, and swamp white oak.

DISTRIBUTION AND EXTENT: Southern half of Lower Michigan. The Wixom soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Gratiot County, Michigan, 1975.

REMARKS: Classification changed to agree with ST Issue #17 on 2 Sept 94 by CLG.

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - the zone from the surface to 9 inches (Ap horizon);
Albic horizon - the zones from 9 to 14 inches and 22 to 29 inches (E and E' horizons);
Spodic horizon - the zone from 14 to 22 inches (Bs horizon);
Argillic horizon - the zone from 29 to 34 inches (2Bt horizon).

LOCATION ESSEXVILLE MI+MN
Established Series
Rev. WEF
09/2004

ESSEXVILLE SERIES

The Essexville series consists of very deep, poorly drained and very poorly drained soils formed in 18 to 40 inches of sandy material overlying loamy glacial drift on lake plains and till plains. These soils have rapid permeability in the sandy material and moderately slow permeability in the loamy material. Slopes range from 0 to 2 percent. Mean annual precipitation is about 32 inches, and mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Sandy over loamy, mixed, active, calcareous, mesic Typic Endoaquolls

TYPICAL PEDON: Essexville loamy sand - on a nearly level area of 1 percent slope on a lake plain in an idle field. (Colors are for moist soils unless otherwise stated.)

Ap--0 to 11 inches; black (10YR 2/1) loamy sand; dark gray (10YR 4/1) dry; few fine prominent dark brown (7.5YR 4/4) mottles; weak fine granular structure; very friable; common fine roots; slight effervescence; mildly alkaline; clear wavy boundary. (11 to 14 inches thick)

Bg--11 to 16 inches; dark grayish brown (10YR 4/2) sand; few fine prominent dark brown (7.5YR 4/4) mottles; single grain; loose; few fine roots; slight effervescence; mildly alkaline; gradual irregular boundary. (0 to 10 inches thick)

C--16 to 26 inches; pale brown (10YR 6/3) sand; few fine prominent strong brown (7.5YR 5/6) and few fine distinct brownish yellow (10YR 6/6) mottles; single grain; loose; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary. (0 to 18 inches thick)

2Cg1--26 to 46 inches; grayish brown (10YR 5/2) loam; few fine distinct yellowish brown (10YR 5/4) and few fine faint gray (l0YR 6/1) mottles; massive; friable; slight effervescence; mildly alkaline; clear wavy boundary. (0 to 30 inches thick)

2Cg2--46 to 60 inches; gray (10YR 6/1) loam; common medium prominent yellowish brown (10YR 5/6) and few medium faint grayish brown (10YR 5/2) mottles; massive; friable; strong effervescence; moderately alkaline.

TYPE LOCATION: Bay County, Michigan; about 6 miles east and 1 mile south of Essexville; 300 feet north and 1,215 feet west of the center of sec. 25, T. 14 N., R. 6 E.

RANGE IN CHARACTERISTICS: The depth to the 2C horizon ranges from 18 to 35 inches. The depth to effervescence ranges from 0 to 10 inches. Rock fragment content ranges from 0 to 15 percent in the A, B and C horizons and from 0 to 5 percent in the 2C horizons.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Uncultivated areas have 10YR hue, value of 2 or 3, and chroma of 1, or is neutral. In some pedons the lower part of the mollic epipedon has distinct or prominent mottles. A horizons are sand, fine sand, loamy sand, loamy fine sand, or sandy loam.

The B horizon has 10YR or 2.5Y hue, value of 4 to 6, and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand.

The C horizon has hue of 5Y to 10YR, value of 4 to 6, and chroma of 1 to 4. In many pedons this horizon is mottled. Chromas of 2 are a result of uncoated mineral grains in pedons that do not have mottles. The C horizon is sand, fine sand, loamy sand, or loamy fine sand.

The 2C horizon has hue of 5Y to 5YR, value of 4 to 6, and chroma of 1 to 4. It is loam, clay loam, or silty clay loam.

COMPETING SERIES: There are no competing series. Closely related is the Belleville series. Belleville soils do not have effervescence in the 10 to 20 inch zone.

GEOGRAPHIC SETTING: Essexville soils are on lake plains and till plains of Wisconsinan age. Slopes range from 0 to 2 percent. They formed in 18 to 40 inches of sandy material overlying loamy glacial drift. Mean annual temperature ranges from 45 to 52 degrees F. Mean annual precipitation is 29 to 37 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: Essexville soils are associated with the poorly drained Tappan and Kingsville soils, the poorly drained and very poorly drained Belleville soils, and the somewhat poorly drained Wixom soils. Tappan soils are fine-loamy. Kingsville soils are sandy and noncalcareous. Wixom soils are noncalcareous and do not have mollic epipedons.

DRAINAGE AND PERMEABILITY: Poorly and very poorly drained. Surface runoff is very slow or ponded. Permeability is rapid in the upper sandy horizons and moderately slow in the 2C horizons.

USE AND VEGETATION: Most areas are cultivated. Beans, corn, sugar beets, potatoes, and small grain are the principal crops. A few areas of these soils are in idle land or woodland. Wooded areas are chiefly lowland hardwoods.

DISTRIBUTION AND EXTENT: Saginaw Valley and Thumb Area of Lower Michigan and possibly Minnesota. The series is of small extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Bay County, Michigan; 1930.

REMARKS: Classification was adjusted to agree with ST Issue #17 on 6 Sept 94 by CLG. Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to 11 inches (Ap horizon); aquic soil moisture regime.

LOCATION TAPPAN MI
Established Series
Rev. LHL-WEF-MLK
01/2001

TAPPAN SERIES

The Tappan series consists of poorly drained soils formed in calcareous loam till on till plains and moraines. Permeability is moderate or moderately slow in the solum and slow in the C horizon. Slope gradients range from 0 to 2 percent. Mean annual precipitation is 32 inches, and mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, calcareous, mesic Typic Endoaquolls

TYPICAL PEDON: Tappan loam - on a nearly level area of 1 percent on till plain cropped to navy beans. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 11 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak coarse granular structure; friable; few fine roots; about 1 percent gravel; slight effervescence; moderately alkaline; abrupt smooth boundary. (8 to 12 inches thick)

A--11 to 13 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; few fine roots; about 2 percent gravel; slight effervescence; moderately alkaline; abrupt wavy boundary. (0 to 4 inches thick)

Bg1--13 to 15 inches; light brownish gray (10YR 6/2) (50 percent) and gray (10YR 5/1) (50 percent) loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; about 5 percent gravel and cobbles; slight effervescence; moderately alkaline; clear wavy boundary.

Bg2--15 to 21 inches; grayish brown (10YR 5/2) (60 percent) and dark yellowish brown (10YR 4/4) (40 percent) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; friable; about 6 percent gravel and cobbles; strong effervescence; moderately alkaline; clear wavy boundary.

Bg3--21 to 31 inches; gray (10YR 5/1) loam; common medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate thick platy structure parting to moderate angular blocky; firm; about 4 percent gravel and cobbles; strong effervescence; moderately alkaline; gradual wavy boundary. (Combined thickness of the Bg horizon is 3 to 25 inches.)

C1--31 to 48 inches; yellowish brown (10YR 5/4) loam; common medium distinct gray (10YR 5/1) and common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse angular blocky fragments; firm; about 4 percent gravel and cobbles; strong effervescence; moderately alkaline; gradual smooth boundary.

C2--48 to 60 inches; yellowish brown (10YR 5/4) loam; few fine distinct yellowish brown (10YR 5/6) and few medium distinct light gray (10YR 6/1) mottles; weak thick platy fragments; firm; about 4 percent gravel and cobbles; strong effervescence; moderately alkaline.

TYPE LOCATION: Huron County, Michigan; about 4 miles west and 1 mile south of Owendale; 152 feet south and 2,340 feet west of the northeast corner, sec. 19, T. 15 N., R. 10 E.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 11 to 36 inches. The mollic epipedon ranges from 8 to 14 inches in thickness. The surface 10 inches is mildly alkaline without effervescence in some pedons. Gravel and cobble content throughout the profile ranges from 1 to 10 percent.

The A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. They are loam, sandy loam, mucky loam, or mucky silt loam. Some pedons have a thin loamy sand surface layers.

The Bg horizons have hue of 5Y to 10YR, value of 4 to 6, and chroma of 1 or 2. The texture is dominantly loam or clay loam, but textures of silt loam or sandy loam are found in the upper part of the Bg horizon in some pedons.

The C horizons have hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is loam, silt loam, silty clay loam, or clay loam. Consistence is firm or very firm.

COMPETING SERIES: There are no competing series. Closely related are the Canisteo, Hetz, Hooppole, Jeffers, Kish and Tilfer series. These soils are superactive. Also, Canisteo and Kish soils have thicker mollic epipedons. Hetz soils are in areas receiving less precipitation. Hooppole soils have sand within 40 to 60 inches. Jeffers soils contain gypsum in their solum and are found in areas receiving less precipitation. Tilfer soils have limestone bedrock within 40 inches.

GEOGRAPHIC SETTING: Tappan soils are on nearly level and depressional areas of till plains and moraines. Slopes range from 0 to 2 percent. They formed in calcareous loam till of Wisconsinan Age. Mean annual temperature ranges from 44 to 48 degrees F. Mean annual precipitation ranges from 28 to 36 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: Tappan soils are associated with the poorly drained Parkhill soil and the somewhat poorly drained Londo and Corunna soils. Parkhill, Londo, and Corunna soils are more deeply leached.

DRAINAGE AND PERMEABILITY: Poorly drained. Potential for surface runoff is medium or high. Surface runoff is slow to ponded. Permeability is moderate or moderately slow in solum and slow in C horizon.

USE AND VEGETATION: Soils are mostly cultivated. Corn, sugar beets, beans, and small grain are the principal crops.

DISTRIBUTION AND EXTENT: Thumb area and east-central part of Lower Michigan. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Sanilac County, Michigan, 1955. The source of the name is a local road.

REMARKS: Classification changed to agree with ST Issue #17 on 2 Sept 94 by CLG. Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to 13 inches (Ap and A horizons); cambic horizon - the zone from 13 to 31 inches (Bg1, Bg2, Bg3 horizons); aquic soil moisture regime; calcareous feature - effervescence throughout control section.

Bay County, Michigan

23—Tappan loam

Map Unit Setting

Elevation: 580 to 820 feet
Mean annual precipitation: 30 to 32 inches
Mean annual air temperature: 45 to 47 degrees F
Frost-free period: 157 to 198 days

Map Unit Composition

Tappan and similar soils: 85 percent
Minor components: 15 percent

Description of Tappan

Setting

Landform: Flats on till plains, depressions on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy till

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 35 percent
Available water capacity: High (about 10.9 inches)

Interpretive groups

Land capability (nonirrigated): 2w

Typical profile

0 to 10 inches: Loam
10 to 13 inches: Loam
13 to 29 inches: Clay loam
29 to 34 inches: Loam
34 to 42 inches: Loam
42 to 80 inches: Loam

Minor Components

Londo

Percent of map unit: 7 percent
Landform: Knolls on till plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex

Belleville

Percent of map unit: 4 percent
Landform: Depressions on till plains, flats on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Poseyville

Percent of map unit: 4 percent
Landform: Knolls on till plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex

Data Source Information

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Bay County, Michigan

16—Essexville loamy sand

Map Unit Setting

Elevation: 570 to 600 feet
Mean annual precipitation: 31 to 31 inches
Mean annual air temperature: 46 to 47 degrees F
Frost-free period: 157 to 198 days

Map Unit Composition

Essexville and similar soils: 85 percent
Minor components: 15 percent

Description of Essexville

Setting

Landform: Drainageways, flats on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial and/or glaciolacustrine deposits over loamy till

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 35 percent
Available water capacity: Moderate (about 8.4 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 11 inches: Loamy sand
11 to 16 inches: Sand
16 to 26 inches: Sand
26 to 46 inches: Loam
46 to 80 inches: Loam

Minor Components

Tappan

Percent of map unit: 8 percent
Landform: Drainageways, flats on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Wixom

Percent of map unit: 7 percent
Landform: Knolls on till plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex

Data Source Information

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009

Bay County, Michigan

17A—Wixom loamy sand, 0 to 3 percent slopes

Map Unit Setting

Elevation: 580 to 820 feet
Mean annual precipitation: 30 to 32 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 157 to 198 days

Map Unit Composition

Wixom and similar soils: 90 percent
Minor components: 10 percent

Description of Wixom

Setting

Landform: Knolls on till plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Sandy glaciofluvial deposits and/or glaciolacustrine deposits over loamy till

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Available water capacity: Moderate (about 8.3 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 9 inches: Loamy sand
9 to 11 inches: Sand
11 to 19 inches: Sand
19 to 26 inches: Sand
26 to 32 inches: Loam
32 to 80 inches: Loam

Minor Components

Londo

Percent of map unit: 6 percent
Landform: Knolls on till plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear

Across-slope shape: Convex

Belleville

Percent of map unit: 2 percent
Landform: Depressions on till plains, flats on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Tappan

Percent of map unit: 2 percent
Landform: Flats on till plains, depressions on till plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Data Source Information

Soil Survey Area: Bay County, Michigan
Survey Area Data: Version 7, Dec 14, 2009